SERVICE MANUAL

Transport Incubator

From Hill-Rom Air-Shields

Product No. TI500/TI500-1/TI500-1E/TI500-1C

For Parts or Technical Assistance
USA (800) 445-3720 Canada (800) 267-2337
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Transport Incubator Service Manual

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Chapter 1 Introduction

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Purpose

This manual provides requirements for the Transport Incubator normal operation and maintenance. It also includes parts lists (in chapter 5) for ordering replacement components.

Audience

This manual is intended for use by only facility-authorized personnel. Failure to observe this restriction can result in severe injury to people and serious damage to equipment.

Organization

This manual contains seven chapters.

Chapter 1: Introduction

In addition to a brief description of this service manual, chapter 1 also provides a product overview.

Chapter 2: Troubleshooting Procedures

Repair analysis procedures are contained in this chapter. Use these procedures to gather information, identify the maintenance need, and verify the effectiveness of the repair.

Chapter 3: Theory of Operation

This chapter describes the application of the mechanical, electrical, and hydraulic systems employed in this product.

Chapter 4: Removal, Replacement, and Adjustment Procedures

Chapter 4 contains the detailed maintenance procedures determined necessary in chapter 2.

Chapter 5: Parts List

This chapter contains the warranty, part-ordering procedure, and illustrated parts lists.

Chapter 6: General Procedures

Cleaning, preventive maintenance, and other general procedures are described in this chapter.

Chapter 7: Accessories

A list of additional products, that can be used in conjunction with the Transport Incubator, is available in chapter 7. Installation procedures for these accessories are also included.

Typographical Conventions

This manual contains different typefaces and icons designed to improve readability and increase understanding of its content. Note the following examples:

- Standard text—used for regular information.
- **Boldface text**—emphasizes a word or phrase.
- **NOTE:**—sets apart special information or important instruction clarification.
- The symbol below highlights a WARNING or CAUTION:

Figure 1-1. Warning and Caution

  - A WARNING identifies situations or actions that may affect patient or user safety. Disregarding a warning could result in patient or user injury.
  - A CAUTION points out special procedures or precautions that personnel must follow to avoid equipment damage.
- The symbol below highlights a CAUGHT HAZARD WARNING:

Figure 1-2. Caught Hazard Warning

- The symbol below highlights a CHEMICAL HAZARD WARNING:

Figure 1-3. Chemical Hazard Warning

- The symbol below highlights an ELECTRICAL SHOCK HAZARD WARNING:

Figure 1-4. Electrical Shock Hazard Warning

The Transport Incubator contains different icons designed to increase understanding. Note the following examples:

- The symbol below indicates “Attention, consult accompanying documents:”

Figure 1-5. Attention, Consult Accompanying Documents

- The symbol below indicates “Type B equipment with an F-type isolated (floating) applied part:”

Figure 1-6. Type B Equipment with an F-Type Isolated (Floating) Applied Part

- The symbol below indicates the **Battery** indicator:

Figure 1-7. Battery Indicator

- The symbol below indicates the **Set Temperature** Down arrow key:

Figure 1-8. Set Temperature Down Arrow Key

- The symbol below indicates the **Set Temperature** Up arrow key:

Figure 1-9. Set Temperature Up Arrow Key

- The symbol below indicates the **Silence/Reset** key:

Figure 1-10. Silence/Reset Key

Technical Definitions

This manual contains different technical terms. For the technical definitions of these terms, see table 1-1 on page 1-7.

Table 1-1. Technical Definitions

Term	Definition
Setpoint	The temperature of the incubator selected for operation during use.
Incubator temperature	The air temperature at a point 10 cm (4") above and centered over the mattress surface.
Temperature equilibrium	The condition reached when the average incubator temperature does not vary more than 0.2°C over a period of one hour.
Temperature overshoot	The amount by which the incubator's temperature exceeds the average incubator temperature at temperature equilibrium when the setpoint changes from 30°C (86°F) to 34°C (93°F).
Temperature rise time	The time required for the incubator's temperature to rise to 34°C (93°F) from an ambient of 23°C (73°F) with a 36°C (97°F) setpoint.
Temperature uniformity	The amount by which the average temperature at each of the four points 10 cm (4") above the mattress surface differs from the average incubator temperature at temperature equilibrium. The four points are the centers of the four areas formed by lines dividing the width and length of the mattress surface evenly.
Temperature variability	The variability of the incubator's temperature observed over a 1 hour period after temperature equilibrium is reached.

Introduction

Overview

The Transport Incubator is for transport of high risk, premature, low birth-weight or critically ill newborns. It provides a means to control air temperature and oxygen concentrations, and adds relative humidity. A double-walled hood provides full visibility and an effective thermal and sound barrier from the environment. Arm ports and door panels provide front and head access, and the mattress tray slides out of the head end for additional access. Tubing access grommets are on both sides of the front access panel and at the left-hand, head end panel. An observation lamp is also included.

The Transport Incubator operates from either a sine- or square-wave AC power source. In addition, it can operate from an external 12V DC or 28V DC source or integral 12V batteries. The batteries automatically charge whenever the unit is connected to an AC voltage source and the main **Power** switch is set to the ON-1 position. A comprehensive visual and audible alarm system is included with a test function to verify proper alarm operation. A **Battery** indicator is also provided.

Operating Precautions

For additional operating precautions for the Transport Incubator and its accessories, refer to the *Transport Incubator (Model TI500) User Manual* (usr038).

Features

Temperature Control

A temperature sensor, located in the recirculation air path, and a proportional control circuit, which determines the heater output to maintain the desired incubator temperature, regulate the incubator temperature. The relative amount of heat provided is indicated by the number of **Heater** indicators lit on the control panel. The incubator temperature can be maintained at 38.0°C (100.4°F) as selected by the temperature controls on the control panel. The temperature, as sensed by a sensor located within the housing, is compared with the setpoint. Control circuitry uses the information from this sensor to proportion the heater output to maintain the setpoint. The temperature appears on the front panel's **Temperature** display.

The initial setpoint is 36.0°C (96.8°F) ± 0.1°C. The incubator heats to this temperature unless the setting is changed. To change the setpoint to a prescribed temperature, use the **Set Temp** controls on the control panel. An additional sensor within the housing serves as a backup to limit the incubator's maximum air temperature to 38.9°C (102.0°F) ± 0.5°C. At this limit, the **High Temp** alarm activates, and the heater shuts off.

Alarms

Each time the unit turns on, it automatically activates a test sequence to verify that the visual display and the audible alarm function. Each of the following six alarms has an indicator on the display and an audible alarm.

High Temperature Alarm

When the incubator temperature is ≥38.9°C (102.0°F), a sensor located below the deck sounds this alarm. A flashing **High Temp** indicator and an audible tone indicate a **High Temp** alarm. Internally, the heater turns off. To silence this alarm for 5 minutes, press the **Silence/Reset** key.

Sensor Alarm

Circuitry monitors the air temperature sensor and the air display sensor for short- or open-circuits or skin temperature probe shorts. A flashing **Sensor** indicator and an intermittent audible tone indicate a **Sensor** alarm. This alarm resets itself.

High Heater Temperature Alarm

A flashing **Heater Temp** indicator and an intermittent audible tone indicate that the heater temperature exceeds 77.0°C (170.6°F). When this occurs, the heater and **Heater** indicators turn off. To silence this alarm for 5 minutes, press the **Silence/Reset** key.

Airflow Alarm

A flashing **Air Flow** indicator and an intermittent audible alarm indicate that the fan impeller is not rotating or is missing. When this occurs, the heater and **Heater** indicators turn off. To silence this alarm for 5 minutes, press the **Silence/Reset** key.

Low DC Alarm

A flashing **Low DC** indicator and an intermittent audible alarm indicate that the incubator's DC power source is below the minimum specification value.

Power Failure Alarm

A separate internal battery powers the **Power Failure** alarm. If AC power is lost and no external DC power source or internal battery is present, the **Power Fail** indicator lights, and a continuous tone sounds. If the power source switches from an AC power source or a DC power source to an internal battery, the **Power Fail** indicator lights, and an intermittent tone sounds. To reset this alarm, press the **Silence/Reset** key.

Adjustable Stand Assembly (Accessory)

The adjustable stand assembly provides a convenient means of moving the Transport Incubator. Each adjustable stand assembly adjusts to different height positions and locks into the litter bar of an ambulance, such as a FERNO®[1] Model 175 Series Cot Fastener System.

1. FERNO® is a registered trademark of Ferno-Washington, Inc.

Specifications

Physical Description

For Transport Incubator physical specifications, see table 1-2 on page 1-11.

Table 1-2. Physical Specifications

Feature	Dimension
Length (with accessory adjustable stand assembly)	102 cm (40")
Width (with accessory adjustable stand assembly)	56.5 cm (22.2")
Height (Model TI500 with accessory adjustable stand assembly)	81.3 cm (32.0") to 111.8 cm (44.0")
Height (Model TI500-1/1E/1C with accessory adjustable stand assembly)	85.73 cm (33¾") to 116.2 cm (45¾")
Weight (including accessory adjustable stand assembly and one battery)	72 kg (159 lb)
Battery tray weight with one battery	10.4 kg (22.9 lb)
Battery tray weight with two batteries	19.4 kg (42.8 lb)
Temperature setpoint range	21.5°C (70.7°F) ± 1.5°C (2.7°F) to 38.0°C (100.4°F) in 0.1°C (0.2°F) increments
Temperature rise time	30 minutes
Temperature variability	≤ 1.0°C (1.8°F)
Temperature overshoot	≤ 2.0°C (3.6°F)
Temperature uniformity	≤ 1.0°C (1.8°F)
Correlation of the displayed incubator temperature to the actual incubator temperature at temperature equilibrium	≤ 1.0°C (1.8°F)
Correlation of the displayed incubator temperature to the setpoint at temperature equilibrium (20°C to 30°C ambients)	≤ 1.5°C (2.7°F)
Correlation of the displayed incubator temperature to the setpoint at temperature equilibrium (10°C to 20°C ambients)	≤ 2.0°C (3.6°F)

Feature	Dimension
Observation light	376.7 lx (35.0 fc) at 10 cm (4") above the center of the mattress
Oxygen concentration range	From 21% to at least 58%
Carbon dioxide (CO_2) level within the hood	< 0.5% when a 4% mixture of CO_2 in the air is delivered at 750 ml/min at 10 cm (4") above the center of the mattress
Noise level within the hood environment	< 60 dBa with ambient noise of ≤ 50 dBa

Environmental Description

For Transport Incubator environmental specifications, see table 1-3 on page 1-12.

Table 1-3. Environmental Specifications

Feature	Dimension
Operating temperature	Maintained at a differential of 25°C between the ambient temperature and the setpoint for 90 minutes per battery
Normal operating temperature range	10°C (50°F) to 30°C (86°F)
Limited operating temperature range	0°C (32°F) to 40°C (104°F)
Relative humidity (RH) operating range	0% to 95%, non-condensing
Altitude operating range (non-pressurized ambient atmosphere)	Sea level to 3 km (9843 ft)
Altitude operating range (pressurized ambient atmosphere)	Sea level to 12 km (39370 ft)
Altitude shipment range	Sea level to 12 km (39370 ft)

Electrical Description

For Transport Incubator electrical specifications, see table 1-4 on page 1-13.

Table 1-4. Electrical Specifications

Feature	Dimension
AC external power requirements (100V/120V model only)	100V/120V, 50/60/400 Hz, 270 W maximum, sine- or square-wave
AC external power requirements (220V/240V and CE mark models only)	220V/240V, 50/60/400 Hz, 270 W maximum, sine- or square-wave
DC external power requirements (100V/120V model only)	11V to 13V, 200 W maximum or 26V to 30V, 200 W maximum typical aircraft voltages
Internal battery type	Gel-type, vented, rechargeable
Internal battery voltage	12V DC nominal
Internal battery quantity	One (or two, with the accessory second battery option)
Internal battery capacity	24 ampere hours per battery
Internal battery charge time (from full discharge)	10 hours per battery
Internal battery life expectancy	200 complete charge/discharge cycles
Chassis current leakage (100V/120V model only)	≤ 300 μA
Chassis current leakage (220V/240V and CE mark models only)	≤ 500 μA

Regulations, Standards, and Codes

The Transport Incubator is classified as International Electrotechnical Commission (IEC) Class 1, internally-powered equipment.

Model Identification and Series Changes

For Transport Incubator model identification and series changes, see table 1-5 on page 1-14.

Table 1-5. Model Identification and Series Changes

Model Number	Description
TI500 Series 00	Transport Incubator original design
TI500 Series 01	Transport Incubator with increased spacing between the control P.C. board and its chassis
TI500 Series 02	Transport Incubator with the resistor changed to the monitor motor circuit on the control P.C. board
TI500-1/1E/1C Series 00	220V/240V Transport Incubator original design

For Transport Incubator power chassis assembly model identification and series changes, see table 1-6 on page 1-14.

Table 1-6. Chassis Assembly Model Identification and Series Changes

Model Number	Description
TI500P-1/1E Series 00	Power chassis assembly original design
TI500P-1/1E Series 01	Power chassis assembly with reduced patient current leakage
TI500P-1/1E Series 02	Power chassis assembly with added trickle charge circuitry on the power P.C. board assembly

Safety Tips

WARNING:
Only facility-authorized personnel should troubleshoot the Transport Incubator. Troubleshooting by unauthorized personnel could result in personal injury or equipment damage.

WARNING:
During removal and replacement, support the battery tray, and avoid pinch points. Failure to do so could result in personal injury or equipment damage.

WARNING:
Follow the product manufacturer's instructions. Failure to do so could result in personal injury or equipment damage.

WARNING:
When performing cleaning and maintenance procedures, ensure that the oxygen supply to the incubator is turned off and that the incubator is disconnected from the oxygen supply. A fire and explosion hazard exists when cleaning and maintaining the incubator in an oxygen-enriched environment.

WARNING:
The heater fins may be hot enough to burn. Do not touch the heater fins until the unit has cooled for at least 30 minutes.

WARNING:
A dirty air intake filter may affect the oxygen concentrations or cause carbon dioxide build-up. Check the air intake filter on a routine basis, and change it at least every 3 months. Failure to do so could result in infant injury.

WARNING:
Follow the product manufacturer's instructions. Failure to do so could result in infant injury or equipment damage.

WARNING:
After cleaning, install the impeller on the motor shaft. Failure to do so could cause the heater to overheat and become disabled. If the impeller is installed incorrectly, oxygen and temperature could be adversely affected. Ensure that the impeller turns freely after installation.

WARNING:
Only facility-authorized personnel should perform preventive maintenance on the Transport Incubator. Preventive maintenance performed by unauthorized personnel could result in personal injury or equipment damage.

WARNING:
To prevent personal injury, keep fingers clear of moving parts.

WARNING:
Two people should always handle the Transport Incubator. Failure to do so could result in personal injury or equipment damage.

WARNING:
To ensure incubator stability, fully support the weight of the incubator until the height adjustment latch firmly locks in the desired position. Failure to do so could result in personal injury or equipment damage.

WARNING:
If the gas is released rapidly due to damage or another cause, compressed gas cylinders, such as oxygen cylinders, can become hazardous projectiles. To prevent movement or damage from shock or impact to the adjustable stand assembly or incubator, securely fasten the cylinders and tighten the clamp screw as required.

WARNING:
If not all indicators display or the alarm does not sound briefly at the end of the Auto-Test cycle, do not use the incubator. Infant injury or equipment damage could occur.

WARNING:
To prevent accidental opening of the access panel, fully engage the access panel latch. Failure to do so could result in infant injury or equipment damage.

SHOCK HAZARD:
To prevent damage to the equipment, remove all power from the unit. Failure to do so could result in personal injury or equipment damage.

SHOCK HAZARD:
Unplug the unit from its power source. Failure to do so could result in personal injury or equipment damage.

SHOCK HAZARD:
To disconnect the batteries from the incubator, loosen the battery compartment fastening knob, and slide the compartment out approximately 5 cm (2"). Failure to do so could result in personal injury or equipment damage.

SHOCK HAZARD:
Do not expose the unit to excessive moisture. Personal injury or equipment damage could occur.

SHOCK HAZARD:
Before use, check the continuity of the ground between the chassis and the AC plug grounding pin. Failure to do so could result in infant injury or equipment damage.

SHOCK HAZARD:
To ensure grounding reliability, plug the AC power cord only into a properly grounded, three-wire, hospital-grade or hospital-use outlet of the proper voltage and frequency. Do **not** use extension cords. Personal injury or equipment damage could occur.

SHOCK HAZARD:
For adequate external DC voltage, do **not** use a cigarette lighter as the terminal point. Ensure that the ambulance wiring leading to the terminal point is at least 10 gauge and as short as possible. Failure to do so could result in infant injury or equipment damage.

SHOCK HAZARD:
Ensure that the building power source is compatible with the electrical specifications shown on the unit. For proper grounding reliability, plug the power cord only into a properly-marked, hospital-grade receptacle. Do **not** use extension cords. If any doubt exists as to the grounding connection, do not operate the equipment. Infant injury or equipment damage could occur.

CAUTION:
When installing the impeller, do not place excessive axial force on the motor shaft. Damage to the motor bearing could occur.

CAUTION:
Do not use harsh cleaners, solvents, or detergents. Equipment damage could occur.

CAUTION:
Do not use alcohol, acetone, or any organic solvents for cleaning. They could craze the clear acrylic hood.

CAUTION:
Do not expose the hood assembly to direct radiation from germicidal lamps. Ultraviolet radiation from these sources could crack gaskets, fade paint, and craze the clear acrylic hood.

CAUTION:
To avoid damage to the air temperature probe, exercise care when lowering the upper shell onto the lower shell.

CAUTION:
To prevent component damage, ensure that your hands are clean, and

only handle the P.C. board by its edges.

CAUTION:
When handling electronic components, wear an antistatic strap. Failure to do so could result in component damage.

CAUTION:
For shipping and storage, place the removed P.C. board in an antistatic protective bag. Equipment damage can occur.

CAUTION:
Do not use silicone-based lubricants. Equipment damage could occur.

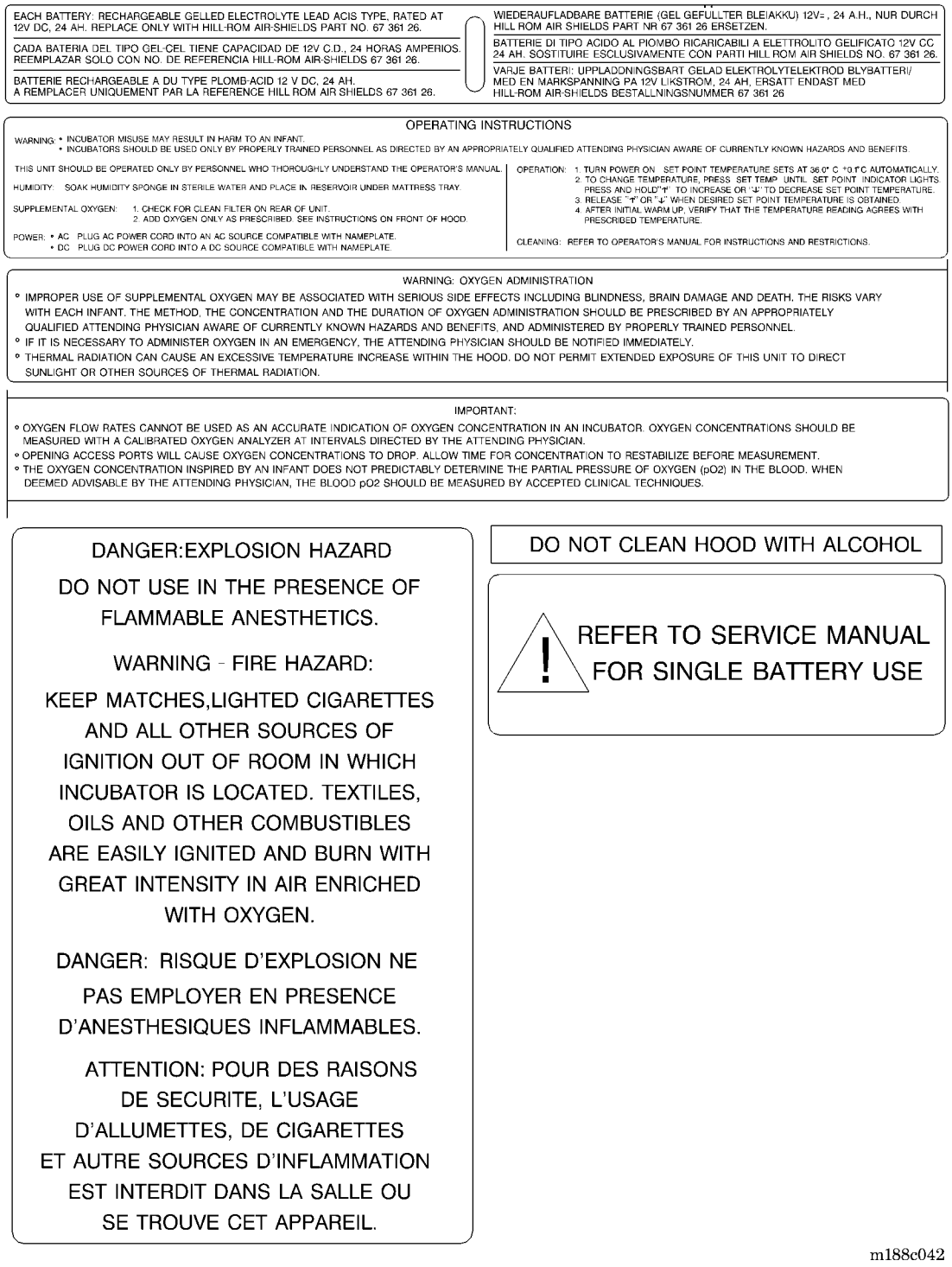
CAUTION:
When removing the equipment from the cartons, take care not to scratch or otherwise damage unprotected surfaces.

CAUTION:
Do not release the frame retaining latches or raise the adjustable stand assembly until the incubator has been installed. Damage to the adjustable stand assembly could occur.

CAUTION:
If the incubator has not been plugged into an AC power source for 20 hours prior to this test, recharge the batteries by plugging the incubator into an AC power source for 20 hours with the **AC Power** switch in the ON-1 position. Failure to do so could result in equipment damage.

Warning and Caution Labels

Figure 1-11. Warning and Caution Labels


EACH BATTERY: RECHARGEABLE GELLED ELECTROLYTE LEAD ACIS TYPE, RATED AT 12V DC, 24 AH. REPLACE ONLY WITH HILL-ROM AIR-SHIELDS PART NO. 67 361 26.
CADA BATERIA DEL TIPO GEL-CEL TIENE CAPACIDAD DE 12V C.D., 24 HORAS AMPERIOS. REEMPLAZAR SOLO CON NO. DE REFERENCIA HILL-ROM AIR-SHIELDS 67 361 26.
BATTERIE RECHARGEABLE A DU TYPE PLOMB-ACID 12 V DC, 24 AH. A REMPLACER UNIQUEMENT PAR LA REFERENCE HILL ROM AIR SHIELDS 67 361 26.
WIEDERAUFLADBARE BATTERIE (GEL GEFULLTER BLEIAKKU) 12V=, 24 A.H., NUR DURCH HILL ROM AIR SHIELDS PART NR 67 361 26 ERSETZEN.
BATTERIE DI TIPO ACIDO AL PIOMBO RICARICABILI A ELETTROLITO GELIFICATO 12V CC 24 AH. SOSTITUIRE ESCLUSIVAMENTE CON PARTI HILL ROM AIR SHIELDS NO. 67 361 26.
VARJE BATTERI: UPPLADDNINGSBART GELAD ELEKTROLYTELEKTROD BLYBATTERI/ MED EN MARKSPANNING PA 12V LIKSTROM, 24 AH, ERSATT ENDAST MED HILL-ROM AIR-SHIELDS BESTALLNINGSNUMMER 67 361 26
OPERATING INSTRUCTIONS
WARNING: • INCUBATOR MISUSE MAY RESULT IN HARM TO AN INFANT.
• INCUBATORS SHOULD BE USED ONLY BY PROPERLY TRAINED PERSONNEL AS DIRECTED BY AN APPROPRIATELY QUALIFIED ATTENDING PHYSICIAN AWARE OF CURRENTLY KNOWN HAZARDS AND BENEFITS.
THIS UNIT SHOULD BE OPERATED ONLY BY PERSONNEL WHO THOROUGHLY UNDERSTAND THE OPERATOR'S MANUAL.
HUMIDITY: SOAK HUMIDITY SPONGE IN STERILE WATER AND PLACE IN RESERVOIR UNDER MATTRESS TRAY.
SUPPLEMENTAL OXYGEN: 1. CHECK FOR CLEAN FILTER ON REAR OF UNIT.
2. ADD OXYGEN ONLY AS PRESCRIBED. SEE INSTRUCTIONS ON FRONT OF HOOD.
POWER: • AC PLUG AC POWER CORD INTO AN AC SOURCE COMPATIBLE WITH NAMEPLATE.
• DC PLUG DC POWER CORD INTO A DC SOURCE COMPATIBLE WITH NAMEPLATE.
OPERATION: 1. TURN POWER ON. SET POINT TEMPERATURE SETS AT 36.0° C ±0.1°C AUTOMATICALLY.
2. TO CHANGE TEMPERATURE, PRESS SET TEMP UNTIL SET POINT INDICATOR LIGHTS. PRESS AND HOLD "↑" TO INCREASE OR "↓" TO DECREASE SET POINT TEMPERATURE.
3. RELEASE "↑" OR "↓" WHEN DESIRED SET POINT TEMPERATURE IS OBTAINED.
4. AFTER INITIAL WARM UP, VERIFY THAT THE TEMPERATURE READING AGREES WITH PRESCRIBED TEMPERATURE.
CLEANING: REFER TO OPERATOR'S MANUAL FOR INSTRUCTIONS AND RESTRICTIONS.
WARNING: OXYGEN ADMINISTRATION
° IMPROPER USE OF SUPPLEMENTAL OXYGEN MAY BE ASSOCIATED WITH SERIOUS SIDE EFFECTS INCLUDING BLINDNESS, BRAIN DAMAGE AND DEATH. THE RISKS VARY WITH EACH INFANT. THE METHOD, THE CONCENTRATION AND THE DURATION OF OXYGEN ADMINISTRATION SHOULD BE PRESCRIBED BY AN APPROPRIATELY QUALIFIED ATTENDING PHYSICIAN AWARE OF CURRENTLY KNOWN HAZARDS AND BENEFITS, AND ADMINISTERED BY PROPERLY TRAINED PERSONNEL.
° IF IT IS NECESSARY TO ADMINISTER OXYGEN IN AN EMERGENCY, THE ATTENDING PHYSICIAN SHOULD BE NOTIFIED IMMEDIATELY.
° THERMAL RADIATION CAN CAUSE AN EXCESSIVE TEMPERATURE INCREASE WITHIN THE HOOD. DO NOT PERMIT EXTENDED EXPOSURE OF THIS UNIT TO DIRECT SUNLIGHT OR OTHER SOURCES OF THERMAL RADIATION.
IMPORTANT:
° OXYGEN FLOW RATES CANNOT BE USED AS AN ACCURATE INDICATION OF OXYGEN CONCENTRATION IN AN INCUBATOR. OXYGEN CONCENTRATIONS SHOULD BE MEASURED WITH A CALIBRATED OXYGEN ANALYZER AT INTERVALS DIRECTED BY THE ATTENDING PHYSICIAN.
° OPENING ACCESS PORTS WILL CAUSE OXYGEN CONCENTRATIONS TO DROP. ALLOW TIME FOR CONCENTRATION TO RESTABILIZE BEFORE MEASUREMENT.
° THE OXYGEN CONCENTRATION INSPIRED BY AN INFANT DOES NOT PREDICTABLY DETERMINE THE PARTIAL PRESSURE OF OXYGEN (pO2) IN THE BLOOD. WHEN DEEMED ADVISABLE BY THE ATTENDING PHYSICIAN, THE BLOOD pO2 SHOULD BE MEASURED BY ACCEPTED CLINICAL TECHNIQUES.
DANGER:EXPLOSION HAZARD
DO NOT USE IN THE PRESENCE OF FLAMMABLE ANESTHETICS.
WARNING - FIRE HAZARD:
KEEP MATCHES,LIGHTED CIGARETTES AND ALL OTHER SOURCES OF IGNITION OUT OF ROOM IN WHICH INCUBATOR IS LOCATED. TEXTILES, OILS AND OTHER COMBUSTIBLES ARE EASILY IGNITED AND BURN WITH GREAT INTENSITY IN AIR ENRICHED WITH OXYGEN.
DANGER: RISQUE D'EXPLOSION NE PAS EMPLOYER EN PRESENCE D'ANESTHESIQUES INFLAMMABLES.
ATTENTION: POUR DES RAISONS DE SECURITE, L'USAGE D'ALLUMETTES, DE CIGARETTES ET AUTRE SOURCES D'INFLAMMATION EST INTERDIT DANS LA SALLE OU SE TROUVE CET APPAREIL.
DO NOT CLEAN HOOD WITH ALCOHOL
REFER TO SERVICE MANUAL FOR SINGLE BATTERY USE

m188c042

Chapter 2
Troubleshooting Procedures

2

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NOTES:

Getting Started

WARNING:
Only facility-authorized personnel should troubleshoot the Transport Incubator. Troubleshooting by unauthorized personnel could result in personal injury or equipment damage.

Begin each procedure in this chapter with step 1. Follow the sequence outlined (each step assumes the previous step has been completed). In each step, the normal operation of the product can be confirmed by answering **Yes** or **No** to the statement. Your response will lead to another step in the procedure, a repair analysis procedure (RAP), or a component replacement. If more than one component is listed, replace them in the given order.

To begin gathering information about the problem, start with **Initial Actions**.

To isolate or identify a problem and to verify the repair after completing each corrective action (replacing or adjusting a part, seating a connector, etc.), perform the **Function Checks**.

To verify the repair, perform the **Final Actions** after the Function Checks.

If troubleshooting procedures do not isolate the problem, call Hill-Rom Technical Support at (800) 445-3720 for assistance.

Initial Actions

To gather information from operators concerning problems with the Transport Incubator, use Initial Actions. Note symptoms or other information concerning the problem that the operator describes. This information helps identify the probable cause.

1. Someone who can explain the problem is available.

   Yes **No**
   ↓ → Go to “Function Checks and General Operation Checkout” on page 2-4.

2. Ask that person to demonstrate or explain the problem. The problem can be duplicated.

   Yes **No**
   ↓ → Go to “Function Checks and General Operation Checkout” on page 2-4.

3. The problem is a result of improper operator action.

   Yes **No**
   ↓ → Go to "Function Checks and General Operation Checkout" on page 2-4.

4. Instruct the operator to refer to the procedures in the *Transport Incubator (Model TI500) User Manual*. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

Function Checks and General Operation Checkout

1. Initial Actions have been performed.

   Yes **No**
   ↓ → Go to "Initial Actions" on page 2-3.

2. Plug the unit into an appropriate AC power source, and turn on the **Power** switch. The **AC** indicator illuminates.

   Yes **No**
   ↓ → Go to RAP 2.1.

3. Perform the following:

   a. Unplug the unit from its AC power source.

   b. Plug the unit into an appropriate external 12V/28V DC power source.

   The **External DC** indicator illuminates.

   Yes **No**
   ↓ → Go to RAP 2.1.

4. Unplug the unit from its external DC power source. The **Battery** indicator illuminates.

   Yes **No**
   ↓ → Go to RAP 2.1.

5. Perform the following:

   a. Plug the unit into an appropriate AC power source.

   b. Turn on the **Power** switch.

   c. Press the **On** key on the controller.

d. Allow approximately 7 seconds for the unit to perform the Auto-Test function. Watch for the following to occur:

- The **High Temp**, **Sensor**, **Heater Temp**, **Airflow**, and **Low DC** alarm indicators flash.
- The **Power Fail** indicator lights steadily.
- The **Air Temperature °C** and the **Baby Temperature** digital displays show all eights, 88.8.

WARNING:
If not all indicators display or the alarm does not sound briefly at the end of the Auto-Test cycle, do not use the incubator. Infant injury or equipment damage could occur.

- If not all indicators display or the audible alarm does not sound briefly at the end of the Auto-Test cycle, do not use the incubator.

NOTE:
If the unit is tested while operating from DC power, the **AC Power Mode** indicator does not light.

- At the end of the Auto-Test sequence, a short beep sounds, the **AC Power Mode** indicator remains on, and one or more of the **Heater** and **Battery** indicators remain on, depending on the incubator's temperature and battery charge.

NOTE:
36°C ± 0.1°C is the automatic initial setpoint. Unless the setpoint is changed, the unit heats to this temperature.

- The **Set Temp** indicator lights, and the **Air Temperature °C** digital display indicates 36°C ± 0.1°C for approximately 15 seconds.
- If the internal batteries require charging, the **Battery** indicator shows one to three lights. If the batteries are fully charged, four **Battery** indicator lights are on.

The Auto-Test function cycles properly.

Yes **No**
↓ → Go to RAP 2.1.

6. The Auto-Test function cycles properly.

Yes **No**
↓ → Go to RAP 2.2.

7. Check the setpoint adjustment:

   a. Press the **Set Temp** key. The **Set Temp** indicator lights to show that the **Air Temperature °C** display indicates the setpoint.

   b. Press and hold the Up arrow key until the **Air Temperature °C** display indicates the maximum, 38°C.

   c. Press and hold the Down arrow key until the **Air Temperature °C** display indicates 34°C.

   The setpoint adjustment operates properly.

   Yes **No**
   ↓ → Calibrate the incubator (refer to procedure 6.4).

8. Check the temperature control:

   a. Close all access openings.

NOTE:
The incubator takes less than 30 minutes nominal to warm up to the setpoint temperature setting.

   b. Allow the incubator to warm up to the setpoint temperature setting of 34°C.

NOTE:
When the temperature display stabilizes, the number of **Heater** indicators illuminated typically reduces to two.

   c. Press the **Set Temp** key.

   After temperature equilibrium is reached, the **Air Temperature °C** display remains within 0.5°C of the setpoint for 15 minutes.

   Yes **No**
   ↓ → Go to RAP 2.3.

9. Turn the observation light on and off by the **On/Off** switch located in the center bottom of the observation light housing. The observation light operates properly.

   Yes **No**
   ↓ → Replace the observation light bulb.

10. To check that the incubator switches from AC power to battery operation, unplug the AC power cord from its power source. The **Battery Power Mode** indicator lights, and the unit continues to operate and maintains the setpoint.

Yes **No**
↓ → Test the batteries (refer to procedure 6.3).

11. Check the **Power Failure** alarm:

    a. Disconnect the external AC and DC power sources from the incubator.

    b. Slide the battery tray out approximately 5 cm (2") to disconnect the internal batteries.

    The **Power Fail** indicator on the controller lights, and a steady alarm sounds.

Yes **No**
↓ → Go to RAP 2.6.

12. Perform the following:

    a. Restore power to the incubator, or press the **Standby** switch on the controller. The alarm terminates.

    b. To check the **High Temperature** alarm, press the **Set Temp** key.

    The **Set Temp** indicator lights to show that the **Air Temperature °C** display indicates the setpoint.

Yes **No**
↓ → Go to RAP 2.7.

13. Perform the following:

    a. Within 15 seconds, simultaneously press and hold both the Up and Down arrow keys, and observe the **Air Temperature °C** display.

NOTE:
After indicating 40°C, the **Air Temperature °C** display rolls back to approximately 20.5°C (68.9°F).

    b. When the **Air Temperature °C** display indicates 40°C, release the Up and Down arrow keys.

NOTE:
During this test, the actual incubator temperature may **not** necessarily correlate to the displayed temperature within 1.0°C.

    c. Allow the incubator to warm up.

When the displayed incubator temperature is 38.9°C ± 0.5°C, the **High Temperature** alarm activates: The **High Temp** indicator flashes, an intermittent tone sounds, and the heater and **Heater Power** indicators turn off.

Yes **No**
↓ → Go to RAP 2.8.

14. Perform the following:
    a. To silence the **High Temperature** alarm, press the **Silence/Reset** key.
    b. Connect the probe simulator to the unit.
    c. Set the air temperature probe simulator to 36.3°C (97.3°F).
    d. Set the skin temperature probe simulator to 36.0°C (96.8°F).
    e. Place the skin temperature probe inside the incubator at 4" (10 cm) above the center mattress.

    The **Baby Temperature** display reads 36.0°C (96.8°F).

    Yes **No**
    ↓ → Go to RAP 2.5.

15. The **Air Temperature** display reads 36.3°C (97.3°F).

    Yes **No**
    ↓ → Go to RAP 2.3.

16. Set the set temperature to 38.0°C (100.4°F). The heater comes on.

    Yes **No**
    ↓ → Go to RAP 2.1.

17. Wait until the **Air Temperature** display reaches the setpoint. The **Air Temperature** controls at 38.0°C (100.4°F).

    Yes **No**
    ↓ → Go to RAP 2.3.

18. Set the probe simulator air temperature to **S1 Short** and then **S1 Open**. The **Sensor** alarm activates.

    Yes **No**
    ↓ → Go to RAP 2.4.

19. Set the probe simulator air temperature to **S2 Short** and then **S2 Open**. The **Sensor** alarm activates.

    Yes **No**
    ↓ → Go to RAP 2.4.

20. Set the probe simulator skin temperature to **Short**. The **Sensor** alarm activates.

    Yes **No**
    ↓ → Go to RAP 2.4.

21. Perform the following:

    a. Disconnect the probe simulator from the unit.

    b. Connect the baby probe to the unit.

    c. Allow the incubator to reach temperature equilibrium.

    The **Baby Temperature** display reads 38.0°C (100.4°F).

    Yes **No**
    ↓ → Go to RAP 2.5.

22. Unless battery charging is required, turn the incubator off by pressing the **Standby** switch on the controller and switching the **AC Power** switch to the OFF-0 position.

Mechanical Checkout

1. To check the access door latches (A), perform the following:

   a. Press the release on the access door latches (A), and ensure that the access door (B) springs open (see figure 2-1 on page 2-10).

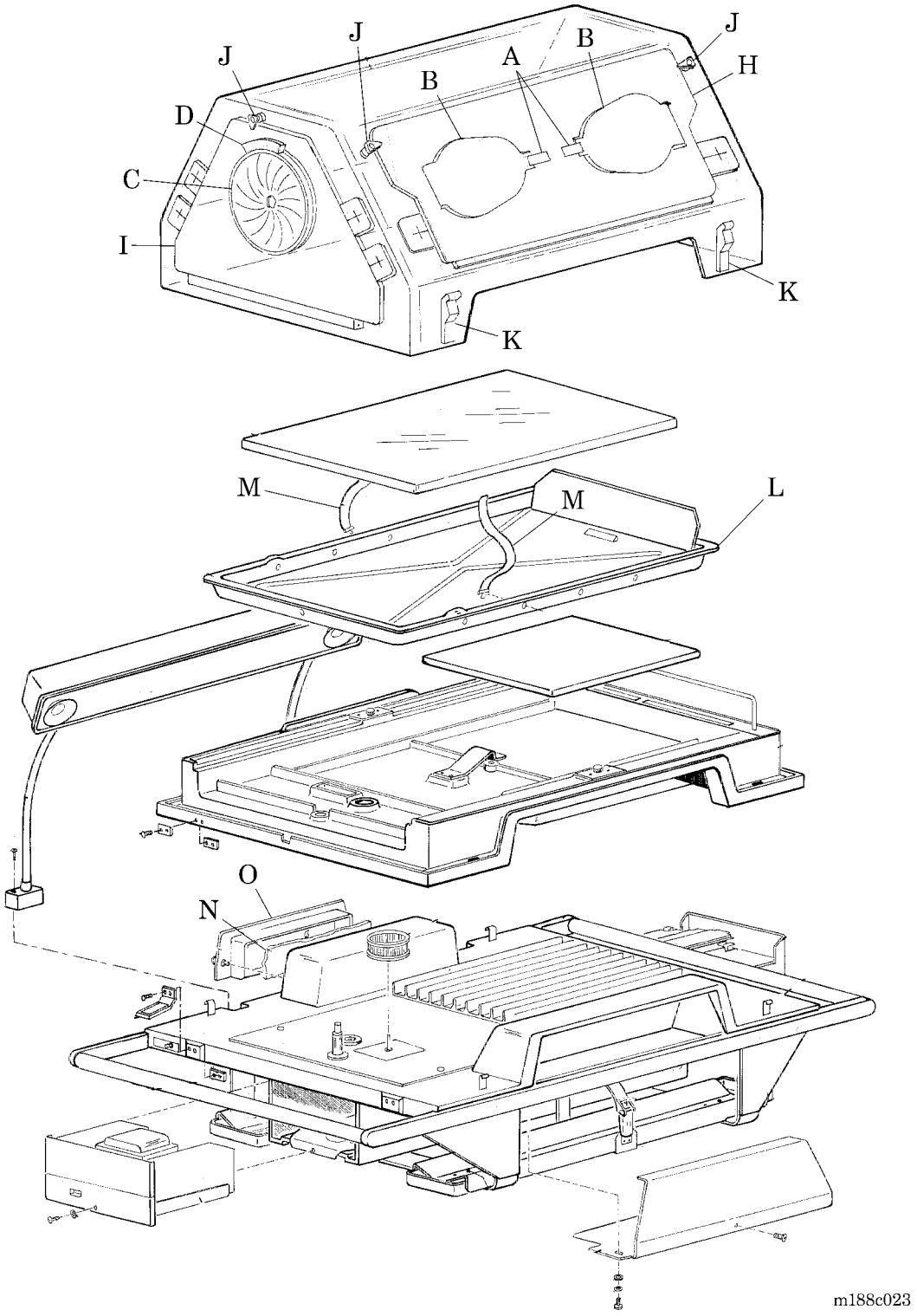
   b. Close the access door (B), and check for proper latching.

2. Check the iris entry port (C):

   a. Rotate the outer ring (D) of the iris entry port (C), and ensure that it opens and closes as rotation continues through 360°.

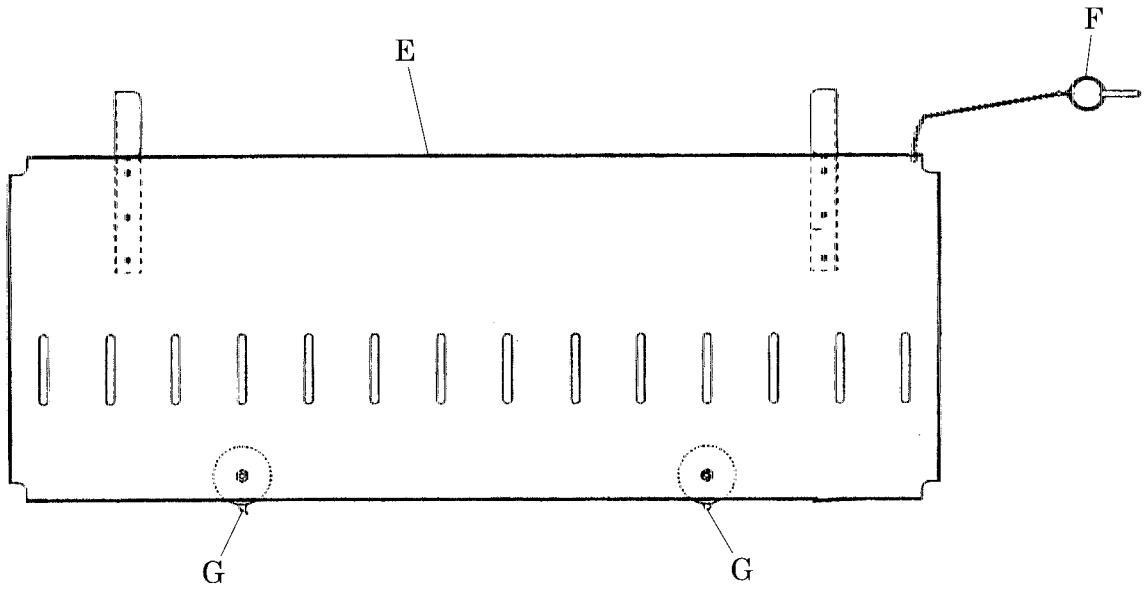
   b. To prevent air leaks during transport, ensure that the iris entry port (C) is installed properly and closed.

Figure 2-1. Transport Incubator



3. If present, check the monitor shelf (E) (see figure 2-2 on page 2-11):

Figure 2-2. Monitor Shelf



Top view

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   a. Remove the locking pin (F) from the right-hand side of the monitor shelf (E).
   b. Grasp the tabs of the suction cups (G), and release the suction cups (G).
   c. Lift up on the monitor shelf (E).
   d. Lower the monitor shelf (E).
   e. Install the locking pin (F).

4. To check the front access panels (H) and head end access panel (I), rotate the panel latches (J), and hang each access panel (H and I) down to the fully open position (see figure 2-1 on page 2-10).

5. Check the shell latches and hood retainers (K). Ensure that all four shell latches and hook retainers (K) are properly secured.

WARNING:
To prevent accidental opening of the access panel, fully engage the access panel latch. Failure to do so could result in infant injury or equipment damage.

6. To check the head end panel latch (J), close the head end access panel (I), and rotate the panel latch (J) until it is fully engaged.

7. Check the mattress tray (L):
   a. Open the head end access panel (I).
   b. Slide the mattress tray (L) out of the incubator until it reaches its mechanical stop.
   c. Push down on the mattress tray (L) in its extended position, and ensure that it is stable.
   d. Return the mattress tray (L) to the incubator.
   e. Check that the retaining straps (M) are in good working order.
   f. Close the head end access panel (I).

8. Check the condition of the air intake filter (N):
   a. Loosen the two thumbscrews on the air filter cover (O), and remove the air filter cover (O).
   b. Remove the air intake filter (N).

WARNING:
A dirty air intake filter may affect the oxygen concentrations or cause carbon dioxide build-up. Check the air intake filter on a routine basis, and change it at least every 3 months. Failure to do so could result in infant injury.

   c. If the air intake filter (N) is visibly dirty, replace it.

9. Check the air and oxygen system:
   a. Using 3/16" inner diameter surgical tubing, connect the output of the Victor Model 1099-0025 flowmeter to the **Oxygen Inlet** connector on the left-hand side of the incubator.
   b. Introduce 6 lpm of oxygen.

c. Monitor the levels within the hood to verify that they reach the predicted level as indicated on the Oxygen Concentration Guide located on the front lower left-hand side of the hood.

10. Upon satisfactory completion of the general operation and functional checkout procedure, perform the following to maintain the batteries at full charge:
    a. Plug the unit into an appropriate AC power source.
    b. Set the **Main AC Power** switch on the power chassis to the ON-1 position.
11. Go to "Final Actions" on page 2-13.

Final Actions

1. Complete the required preventive maintenance procedures. See "Preventive Maintenance Checklist" on page 6-16.
2. Complete all required administrative tasks.

2.1 Power Distribution Does Not Operate Properly

Tools required: Probe simulator (P/N 67 909 75)
Fluke®[1] Model 8087 digital voltmeter (DVM)
4Ω 100 W load resistor
1.5V batteries (2)

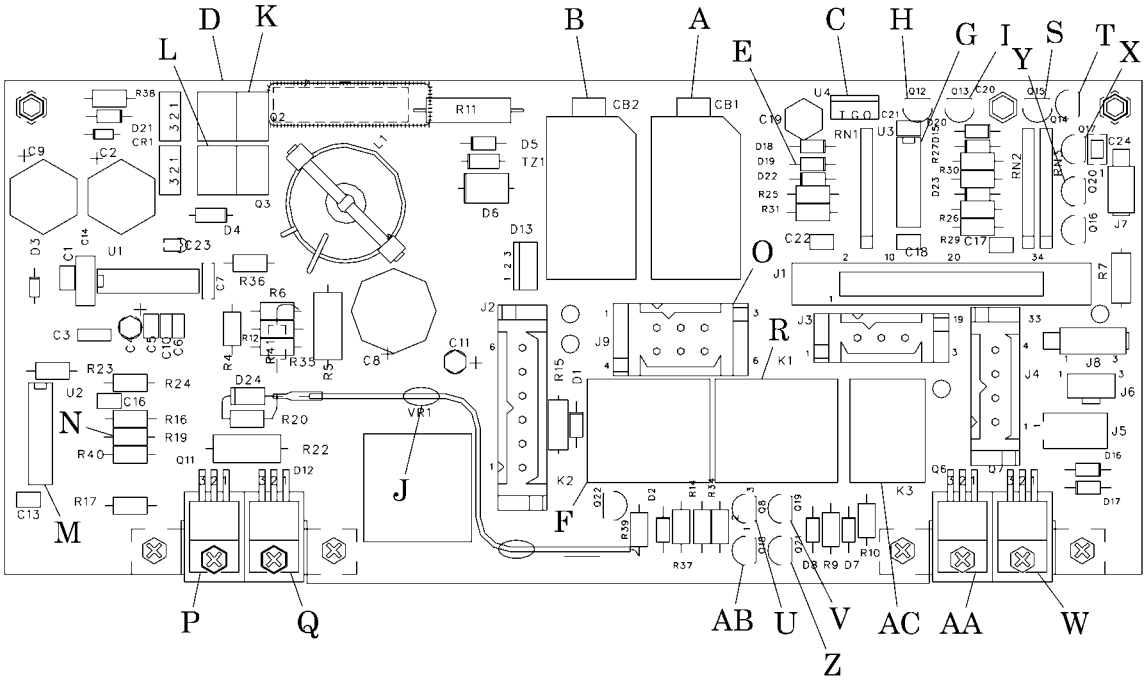
1. Perform the following to check the AC power:
   a. Plug the unit into an appropriate AC power source.
   b. Turn on the **Power** switch.
   c. Connect the calibrated Fluke® Model 8087 digital voltmeter (DVM) between TB2-8 (+) and TB2-6 on the DC power supply.

   The voltage reads +15V DC.

   Yes ↓
   No → At the power P.C. board (D), check the circuit breakers, CB1 (A) and CB2 (B), the **Power** switch, S1, and the power supply (see figure 2-3 on page 2-15). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 2.

1. Fluke® is a registered trademark of Fluke Corporation.

Figure 2-3. Power P.C. Board



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2. Connect the Fluke® Model 8087 DVM between pin 3 on U4 (C) and GND on the power P.C. board (D). The voltage is +5V DC.

   Yes **No**
   ↓ → Check D19 (E) and U4 (C). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 3.

3. K2 (F) energizes.

   Yes **No**
   ↓ → Check U3A (G), Q12 (H), and Q13 (I). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 4.

4. Perform the following:

   a. Connect the Fluke®[1] Model 8087 DVM between pin 1 on VR1 (J) and GND on the power P.C. board (D).

   b. Press the **On** switch on the controller.

1. Fluke® is a registered trademark of Fluke Corporation.

The voltage is +6V DC.

Yes **No**
↓ → Check the switching supply, U11, Q2 (K), and Q3 (L). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 5.

5. The NPWRON signal is present.

Yes **No**
↓ → Replace the controller P.C. board (refer to procedure 4.8). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 6.

6. Connect the Fluke® Model 8087 DVM between pin 3 on VR1 (J) and GND on the power P.C. board (D). The voltage is +12V DC.

Yes **No**
↓ → Check VR1 (J). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 7.

7. Perform the following to check the battery charger:
   a. Unplug the unit from its AC power source.
   b. Disconnect P9 from the power P.C. board (D).
   c. Connect a 4Ω, 100 W load resistor across J9 (O), pins 1 and 5.
   d. Plug the unit into an appropriate AC power source.
   e. Turn on the **Power** switch.
   f. Connect the Fluke® Model 8087 DVM between CB2 (B) and GND.
   g. Connect two 1.5V batteries to the circuit GND, and momentarily apply +3V DC to the U2 (M) side of R19 (N).

   At least 12V DC ± 0.7V DC is present.

Yes **No**
↓ → Check U2 (M), Q11 (P), and D12 (Q). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 8.

8. Perform the following to check the external DC power:
   a. Disconnect the resistor from J9 (O).
   b. Connect P9 on the power P.C. board (D).

c. Unplug the unit from its AC power source.

d. Plug the unit into an appropriate external 12V DC power source.

K1 (R) energizes.

Yes **No**
↓ → Check U3B (G), Q15 (S), and Q14 (T). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 9.

9. Perform the following to check the heater circuitry:

   a. Unplug the unit from its external 12V DC power source.

   b. Plug the unit into an appropriate AC power source.

   c. Connect the probe simulator to the unit.

   d. Set the **Air Temperature** display to 36.0°C (96.8°F).

   e. Set the **Baby Temperature** display to 36.0°C (96.8°F).

   f. Set the set temperature to the base of 38.0°C (100.4°F).

   The heater is on.

   Yes **No**
   ↓ → Go to step 11.

10. Go to step 14.

11. The HCTRL signal is at Q8 (U).

    Yes **No**
    ↓ → Replace the controller P.C. board (refer to procedure 4.8). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, call Hill-Rom Technical Support at (800) 445-3720.

12. Check Q8 (U), Q19 (V), and Q7 (W). If necessary, replace the power P.C. board (D) (refer to procedure 4.9).This solves the problem.

    Yes **No**
    ↓ → Perform a continuity check on the 12V heater. If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, call Hill-Rom Technical Support at (800) 445-3720.

13. Go to "Final Actions" on page 2-13.

14. Perform the following:

    a. Unplug the unit from its AC power source.

b. Plug the unit into an external 28V DC power source.

The heater is on.

Yes **No**
↓ → Go to step 16.

15. Go to step 20.

16. The NOVR16 signal is at the base of Q7 (W).

Yes **No**
↓ → Check U3C (G), Q17 (X), and Q20 (Y). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, call Hill-Rom Technical Support at (800) 445-3720.

17. Check Q8 (U), Q19 (V), Q21 (Z), and Q6 (AA). If necessary, replace the power P.C. board (D) (refer to procedure 4.9). This solves the problem.

Yes **No**
↓ → Perform a continuity check on the 28V heater.

18. Perform a continuity check on the 12V heater. There is continuity.

Yes **No**
↓ → For assistance, call Hill-Rom Technical Support at (800) 445-3720.

19. Go to "Final Actions" on page 2-13.

20. Perform the following:

a. Unplug the unit from its external 28V DC power source.

b. Plug the unit into an appropriate AC power source.

c. Set the probe simulator to 39.5°C (103.1°F).

The heater is off.

Yes **No**
↓ → Go to step 22.

21. For assistance, call Hill-Rom Technical Support at (800) 445-3720.

22. The HDSBL signal is at Q18 (AB).

Yes **No**
↓ → Replace the controller P.C. board (refer to procedure 4.8). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, call Hill-Rom Technical Support at (800) 445-3720.

23. Check Q18 (AB) and K3 (AC). This solves the problem.

Yes	No
↓	→ For assistance, call Hill-Rom Technical Support at (800) 445-3720.

24. Go to “Final Actions” on page 2-13.

2.2 The Auto-Test Function Does Not Operate Properly

NOTE:
The Auto-Test cycle lasts for approximately 7 seconds. Therefore, you may have to turn the unit on and off several times to complete the following actions.

1. Perform the following:

   a. Plug the unit into an appropriate AC power source.

   b. On the controller, press the **On** key.

   The Auto-Test function displays the following:

- The **Air Temperature** display and the **Baby Temperature** display shows all eights (88.8).
- The **Heater** indicators and the **Battery** indicator light.
- All **Heater** indicators, except for the **Power Fail** indicator, flash.
- The **Power Fail** indicator lights steady.

   Yes **No**
   ↓ → Go to step 3.

2. For assistance, call Hill-Rom Technical Support at (800) 445-3720.

3. The **Power Fail** alarm activates.

   Yes **No**
   ↓ → Check the **Power Fail** alarm battery. Replace if necessary. If this solves the problem, go to “Final Actions” on page 2-13. Otherwise, go to step 6.

4. Go to RAP 2.1. This solves the problem.

   Yes **No**
   ↓ → For assistance, call Hill-Rom Technical Support at (800) 445-3720.

5. Go to “Final Actions” on page 2-13.

6. Replace the controller P.C. board (refer to procedure 4.8). This solves the problem.

   Yes **No**
   ↓ → For assistance, call Hill-Rom Technical Support at (800) 445-3720.

7. Go to “Final Actions” on page 2-13.

2.3 The Air Temperature Display Does Not Function Properly

1. Perform the following:
   a. To silence the **High Temperature** alarm, press the **Silence/Reset** key.
   b. Connect the probe simulator to the unit.
   c. Set the air temperature probe simulator to 36.3°C (97.3°F).
   d. Set the skin temperature probe simulator to 36.0°C (96.8°F).
   e. Place the skin temperature probe inside the incubator at 4" (10 cm) above the center mattress.

2. The **Air Temperature** display reads 36.3°C (97.3°F).

   Yes ↓
   No → Replace the controller P.C. board (refer to procedure 4.8). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 3.

3. Set the set temperature to 38.0°C (100.4°F). The heater comes on.

   Yes ↓
   No → Go to RAP 2.1. If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 4.

4. Wait until the **Air Temperature** display reaches the setpoint. The **Air Temperature** controls at 38.0°C (100.4°F).

   Yes ↓
   No → Replace the air temperature probe. If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, go to step 5.

5. Replace the controller P.C. board (refer to procedure 4.8). This solves the problem.

   Yes ↓
   No → For assistance, call Hill-Rom Technical Support at (800) 445-3720.

6. Go to "Final Actions" on page 2-13.

2.4 The Sensor Alarm Does Not Activate

1. Replace the controller P.C. board (refer to procedure 4.8). This solves the problem.

   Yes **No**
   ↓ → For assistance, call Hill-Rom Technical Support at (800) 445-3720.

2. Go to “Final Actions” on page 2-13.

2.5 The Baby Temperature Alarm Does Not Function Properly

1. Perform the following:

   a. Connect the baby probe to the unit.

   b. Place the baby probe inside the incubator

   c. Allow the incubator to reach temperature equilibrium.

   The **Baby Temperature** display reads 38.0°C (100.4°F).

   Yes **No**
   ↓ → Replace the baby probe. If this solves the problem, go to “Final Actions” on page 2-13. Otherwise, go to step 2.

2. Replace the controller P.C. board (refer to procedure 4.8). This solves the problem.

   Yes **No**
   ↓ → For assistance, call Hill-Rom Technical Support at (800) 445-3720.

3. Go to “Final Actions” on page 2-13.

2.6 The Power Failure Alarm Does Not Function Properly

1. Perform the following:
   a. Disconnect the external AC and DC power sources from the incubator.
   b. Slide the battery tray out approximately 5 cm (2"), and disconnect the internal batteries.

   The **Power Fail** indicator on the controller lights, and a steady alarm sounds.

   Yes **No**
   ↓ → Replace the controller P.C. board (refer to procedure 4.8). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, call Hill-Rom Technical Support at (800) 445-3720 for assistance.

2. To terminate the alarm, perform the following:
   a. Restore power to the incubator.
   b. Press the **Standby** switch on the controller.
   c. Go to "Final Actions" on page 2-13.

2.7 The Set Temp Indicator Does Not Function Properly

1. Replace the controller P.C. board (refer to procedure 4.8). This solves the problem.

   Yes **No**
   ↓ → For assistance, call Hill-Rom Technical Support at (800) 445-3720.

2. Go to “Final Actions” on page 2-13.

2.8 The High Temperature Alarm Does Not Function Properly

1. Press the **Set Temp** key. The **Set Temp** indicator lights to show that the **Air Temperature °C** display indicates the setpoint.

   Yes **No**
   ↓ → Go to RAP 2.7.

2. Perform the following:

   a. Within 15 seconds, simultaneously press and hold both the Up and Down arrow keys, and observe the **Air Temperature °C** display.

NOTE:
After indicating 40°C, the **Air Temperature °C** display rolls back to approximately 20.5°C (68.9°F).

   b. When the **Air Temperature °C** display indicates 40°C, release the Up and Down arrow keys.

NOTE:
During this test, the actual incubator temperature may **not** necessarily correlate to the displayed temperature within 1.0°C.

   c. Allow the incubator to warm up.

   When the displayed incubator temperature is 38.9°C ± 0.5°C, the **High Temperature** alarm activates: The **High Temp** indicator flashes, an intermittent tone sounds, and the heater and **Heater Power** indicators turn off.

   Yes **No**
   ↓ → Replace the controller P.C. board (refer to procedure 4.8). If this solves the problem, go to "Final Actions" on page 2-13. Otherwise, call Hill-Rom Technical Support at (800) 445-3720 for assistance.

3. Perform the following:

   a. To silence the **High Temperature** alarm, press the **Silence/Reset** key.

   b. Go to "Final Actions" on page 2-13.

Chapter 3
Theory of Operation

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NOTES:

Electrical System

Figure 3-1. Inter-Connection Diagram

Refer to FO 3-1 at the rear of this manual.

Figure 3-2. Controller P.C. Board (PCB1) Schematic

Refer to FO 3-2 at the rear of this manual.

Figure 3-3. Power P.C. Board (PCB2) Schematic

Refer to FO 3-3 at the rear of this manual.

Theory of Operation

A forced air circulating system controls temperature, humidity, and oxygen concentration. A motor-driven impeller draws a controlled amount of room air through the air/oxygen intake filter. To maintain the total gas intake, including oxygen, at the same level, supplemental oxygen, introduced through the oxygen inlet connector on the left-hand side of the unit, displaces a portion of room air. Since the impeller/filter characteristics control the amount of room air and the flow meter setting controls the amount of oxygen, predictable oxygen concentration is attainable. However, use of an FiO_2 monitor is recommended.

In addition to drawing fresh, filtered air into the incubator, the impeller provides an internal recirculation at a much greater flow than that of the fresh gas inflow. The air is directed over the humidity sponge for humidification. When the access panel of the hood is closed, the air enters the infant compartment up through the slots at the right-hand end of the housing. After circulating within the infant compartment, the air then circulates down the left-hand end of the housing, past the temperature sensing probe, and back to the impeller.

The Transport Incubator operates from one of three power sources. Power is selected in the following priority sequence:

- External AC power
- External 12V DC or 28V DC power
- Internal batteries

The batteries can charge only when the unit operates from an external AC power source.

Detailed Circuit Description

The power chassis assembly contains all of the power collection and distribution circuitry necessary for the proper operation of the Transport Incubator.

Input Power Circuit Sources

Electronic circuits on the power P.C. board monitor the voltage level of each of the possible power sources and determine priority.

External AC Power Source

Power from the AC mains goes through the AC receptacle on the power chassis front panel. From there, the power is distributed through the power chassis. First, it connects to the circuit breakers; on the 220V model, there are two 4 A breakers; on the 110V model, there are two 6 A breakers. (The power supply has an auto-ranging input that accepts any voltage from 90V to 264V. However, due to regulatory requirements, two sets of breakers are required, and hence two models.) From there, the AC mains voltage connects to the input of a 225 W switching power supply. The power supply converts the AC mains to 15V DC, and the 15V DC connects to the power P.C. board through connector J2.

From J2, the 15V DC goes through diode D19 to the input of the 5V regulator, U4. This regulator provides power for all of the input-level, detector circuits on the power P.C. board. These circuits choose which power source is used. For the AC mains input, a Schmitt trigger circuit consisting of comparator U3A and its surrounding circuitry monitors the 15V output of the power supply. If the 15V is above the cutout threshold of approximately 13V, the relay K2 energizes, and power from the AC mains, through the 15V power supply, powers the Transport Incubator. 12V is applied to the wiper contact of K2, signal V1228, which supplies power to the on-board switching power supply and the heater.

If a fault occurs, and the voltage falls below 13V, the relay K2 de-energizes, and power reverts to the external DC power source or internal battery, depending on which is present.

External 12V/28V DC Power Source

An external DC power source can power the unit. The power enters the Transport Incubator through the round connector on the power chassis front plate, and from there it connects to the power P.C. board through the connector J3. There are two acceptable voltage levels, 12V DC and 28V DC.

Main 12V/28V Circuit

The internal main 12V/28V circuit adjusts automatically to accommodate either 12V or 28V DC. The DC voltage enters the P.C. board through connector J3, passes through circuit breaker CB1, and then directly connects to the open contact of relay K1. Like the J2 input, a level detector circuit with hysteresis exists. If the voltage is below 9V, relay K1 does not energize. If the voltage is above 9V, relay K1 energizes, and Q14 drives the coil of K1, energizing it, and connecting V1228 to the normally closed contact of K2. This then applies power to V1228, and then to K3 and V1228.

DC 12V/28V Discriminator

The 12V/28V discriminator determines if the external DC power is in the 12V range or the 28V range for the following two purposes:

- To prevent over-driving the K1 relay coil
- To determine which heater driver power field-effect transistors to use

The circuit consisting of U3C is a Schmitt trigger that generates a signal, NOVR16, if the 12V/28V voltage, V1228, is over 16V.

Internal Batteries

The internal batteries are contained in a separate chassis, and connect to the power P.C. board through connector J9. From there, the circuit passes through circuit breaker CB2, and then goes on to the normally closed contact of relay K2. The circuit also connects to the output of the battery charging circuit at the cathode of D12.

Power Source Priority

Since there are three possible power input sources, circuitry controls or automatically selects which source powers the unit.

Power from one of the three input sources is directed to the following two separate circuits:

- The heater circuit
- The input from the 6V switcher that powers the controller P.C. board

AC power has priority over all other sources. If AC power is present, and the main switch is turned on, 15V DC is available at pins 1 and 2 of J2. The schematic name for this signal is VACDC. If VACDC is above 13V, the level detecting circuit included around U3A turns on transistor Q13, and thus activates K2. This connects the arm of K2 to VACDC only. As long as K2 is activated, all other power sources, even if present and activated, are locked out. The arm of K2, pin 30, which is signal V1228, represents the entry point for power to the rest of the unit. This point is the source to the heater and 6V switcher.

If AC power is not present, K2 is deactivated, and pin 30, signal V1228, connects to pin 88, signal ITOE. ITOE connects to the arm of K2. If there is no external DC power, this point connects directly to the battery. If there is an external DC power present, K1 activates, and ITOE connects to the external DC power source through connector J3. Because relay K1 has a 12V coil, the coil drive circuit is selected based on the external voltage. If it is 12V, the U3B level detector activates Q14 and drives the coil directly. If the voltage is 28V, the level detector U3C drives the coil through Q17 and R11 while, at the same time, disabling transistor Q14 through D15.

If both AC power and external DC power are not present, both relays K1 and K2 deactivate, and V1228 connects to the battery.

Battery Charger

Batteries charge through the battery charging circuit comprised of U2 in conjunction with R22, Q11, and D12. The source for this charging circuit is VACDC, which means that the AC power must be present for charging to take place. The battery cannot charge by external DC power.

The battery charging integrated circuit U2, a UC2906, is configured as a dual-level, float charger. Basically, the charger operates as follows:

- The battery charges with a 3 A current until an over-voltage condition is reached—in this case, approximately 15V.
- When this voltage is reached, the charge current drops back to a trickle charge, and the battery voltage is allowed to float.
- When the battery voltage falls below a threshold voltage of about 13.6V, the charging cycle repeats with a 3 A charging current.

The circuitry of the controller P.C. board's **Battery Status** light uses transistor Q22 to disable the charger, so that the presence or absence of a battery can be detected.

Heater Drivers

The heater used in the Transport Incubator is a dual-element, resistive heater with a common connection. Essentially, one element is for 12V/15V operation, and one is used for 28V operation, although the exact use of the elements depends on the power source.

Power Hexfets

Transistors Q6 and Q7 are used to apply power to the heaters. Q6 drives the higher resistance element, while Q7 drives the lower. The pulse-width modulated heater control signal, HCTRL, applies to the gates of Q6 and Q7 indirectly through C8 and C19. When HCTRL goes high, C8 turns on, C19 turns off, D7 and D8 are reverse-biased, and the gates of Q6 and Q7 rise to 6V through R9 and R10, respectively.

Q6 and Q7 may not be used at the same time, depending on which power source is used. For AC mains source, signal SHDNM is high, Q21 is high, and Q6 disables, thereby enabling the lower heater resistance to be used. If external 12V DC or the battery is the source, both Q6 and Q7 are used. If external 28V DC is used, the over-16 signal, NOVR16, activates, and only Q6 is used.

Switching Power Supplies

Regardless of the input voltage source, all input voltages are presented to the input of the 6V switcher and the heater at pin 30 of relay K2. This voltage powers the fan, lights, and, in conjunction with VR1, the controller P.C. board. VR1 is a step-up switching power supply used to generate 12V for operational amplifier operation.

6V

The 6V switching power supply consists of U1, Q2, Q3, and the associated circuitry. This is a DC-to-DC buck converter that takes any voltage from 6V to 30V and converts it to 6V DC at a maximum of 5 A.

12V

VR1 is a self-contained switching regulator that takes its input from the output of the 6V supply and generates 12V at 250 mA.

Fault Protection

Circuit Breakers

Both the external DC power source and the battery have 15 A circuit breakers, CB1 and CB2 respectively. These breakers protect against downstream faults. D13 protects against reverse battery connection.

Since the DC power supply associated with the AC mains supply has internal fault protection, the VACDC signal has no circuit breaker.

Reverse Voltage

If the external DC power is accidentally connected in reverse, the circuit diodes are reversed-biased, and therefore allow no current drain.

If the battery accidentally connects in reverse, D13 is forward-biased, and CB2 opens to protect the power P.C. board circuitry.

Safety Relay

After a power source is selected by the front end of the power P.C. board, power passes on to the heaters through safety relay K3. Q18 and the control signal HDSBL controls the activation of K3's coil. Under normal operation, K3 activates, and thus the V1228 power connects to pin 1 of the heater connector J4. Under fault conditions, HDSBL goes low, and the cutoff drive to the safety relay K3 and power to the heater are interrupted.

Fan Sense

A series current sense resistor, R7, is used to determine motor current. The voltage on this resistor is proportional to fan motor current and is sent to the controller P.C. board for the fan motor alarm circuit.

Exam Lights

The 6V switching power supply on the power P.C. board powers the exam lights. Connector J8 makes this power available.

Feed-Through Connections

For some signals, the power P.C. board is used as a conduit for the following sensor signals going to the controller P.C. board:

- For the skin probe, signals J5, SPR8, and SPRET
- For the air probe, signals J6, AMONPB, PRBRET, and ACTRPB

Controller P.C. Board

The controller P.C. board performs the following functions for the incubator:

- Measures the skin temperature
- Measures and controls the incubator's air temperature
- Monitors, indicates, and displays alarms
- Charges the battery
- Indicates the battery level
- Indicates the battery status

Power On/Off Circuitry

On/Off Switch

The controller P.C. board turns on through the push-button switch, S6, and turns off through S7. The operation of the power on/off circuit is as follows:

- The on/off function centers around the latching relay K1.
- Signal NPWRON controls power to the controller P.C. board and controls the 6V switching power supply on the power P.C. board. A resistor pulls this signal up to 5V. When the unit is off, NPWRON pulls up because it is connected to the open contact pin 4 of K1.
- The charge built-up on capacitor C22 powers K1. Whenever any of the four possible power sources are active, this has 5V on it. Regardless of the voltage at V1228, current through R46 generates 5.1V at Zener CR5, and hence capacitor 22μF.
- When the **On** switch, S6, is pressed, the 5.1V at CPVRR appears on the gate of Q12, turning it on and supplying power to K1's "latch-on" coil. This connects pin 4 to the ground through pin 3, grounding NPVMON, and turns on the switching power supply, and powers up the controller P.C. board, applying 6V and 12V.

Regulators

The 6V and 12V supplies apply to three linear regulators that supply voltages for circuit functions. Regulator VR1 takes the 6V supply and drops it 5.0V to power the digital logic and the digital displays. VR3 drops the 12V supply down to 8V to run the control pulse width circuit. Voltage V1 powers the audio alarm circuit centering on U4. This voltage is derived from the 12V input and drops to about 10.8V through diodes D14 and D13. VR2 generates another 5V source, V2, from 12V to power the setpoint retention circuit. This voltage is available even when the unit is turned off because it is the diode with the 7.2V battery connected to J1.

Skin Temperature

Probe

The skin probe is a single-thermistor type.

Skin Bridge

The skin sensor probe measures the temperature of whatever its probe end is attached to. The thermistor forms parts of a triangular circuit consisting of R69, R128, and RT6.

Signal Amplifier

The operational amplifier U46A amplifies the bridge output voltage. This amplifier provides gain and linearization for the thermistor probe's output. Nominal range of the output voltage is 2V to 4V for a 20°C (68°F) to 40°C (104°F) temperature range. This corresponds to a sensitivity of 100 millivolts (mV)/°C.

Analog/Digital (A/D) Converter and Display

Input voltage to the analog/digital (A/D) converter is attenuated by a factor of approximately 10 by the R70/R119 resistor divider to keep the signal in the A/D converter's operating range of 0mV to 999mV. C29 filters the A/D input voltage for stable display readings. The A/D converter, U24, accepts the analog input and outputs the corresponding digital code as multiplexed BCD digital signals used to drive a three-digit numeric LED display. The A/D converter presents BCD information to the seven-segment decoder/driver, U25, which drives the cathodes of the **Skin Temperature** display, DS16 through DS18. The digital-strobe outputs, U24-3 through -5, of the A/D converter drive the anodes of the display through the drive transistors, Q15 through Q17. The analog switch, U36, provides the display lamp test function

during the Auto-Test cycle at power-up. RT4 and RT5 allow zero and gain adjustment for A/D converter calibration.

Pin 6 of the A/D converter is the “hold” input which, if biased properly, holds the display reading to the last converted number. Diodes D1 and D2 provide this 1.2V bias voltage. NOR gate U5A pin 3 provides control over the “hold” mode. This input eliminates display flickering when the temperature is at a transition point. Output U5-3, NCONVT, is normally high, keeping the A/D converter in the “hold” mode. Every few seconds, a pulse provided through C17 forces U5-3 low and updates the A/D converter temperature information. The C17 and R20 time-constant determines the duration of this pulse.

When the display indicates the setpoint temperature, this “hold” mode must be overridden to provide fast response during the temperature setting operation.

Components D17, R18, and C16 control of “hold” input during the setpoint temperature mode. When the setpoint temperature is displayed, the anode of D17 goes high, forcing U5-3 low. This puts the A/D converter into the fast-conversion mode to allow the setting of the temperature. R18 and C16 provide a delay after the anode of D17 goes low again. This delay keeps U5-3 low, allows time for the analog switches to change, and allows time for the A/D converter to convert the hood temperature and display it. This is preferred rather than holding the control temperature on the display for a few seconds before the hood temperature is again displayed.

Calibration Check

The calibration of the skin temperature measurement can be checked. When switch S1 is pressed, relay K2 energizes. This places a 4300Ω 0.1% calibration resistor in place on the skin probe. If the skin temperature circuit is calibrated, the **Skin Temperature** display reads exactly 36.0°C (96.8°F) after a 3½-second delay for A/D conversion.

Air-Temperature-Monitoring Circuitry

Probe

This probe is a dual-thermistor type. Both thermistors are identical. One is used for monitoring, and the other is used for controlling.

Bridge

Sensor 2TR1-b of the dual-thermistor probe measures the incubator hood temperature and forms parts of a bridge circuit consisting of R58, R59, R123, R126, and RT10.

Amplifier

The bridge amplifier U49A amplifies the bridge output voltage. This amplifier provides gain and linearization for the thermistor probe's output. Nominal range of output voltage is 2V to 4V for a 20°C (68°F) to 40°C (104°F) temperature range. This corresponds to a sensitivity of 100 mV/°C.

A/D Converter and Display

The A/D converter, U26, and displays, DS13 through DS15, have a dual-use. In the normal mode, the display shows the air temperature in the hood. In the setpoint mode, the display shows the current setpoint temperature. A two-input multiplexer to the input of the A/D converter determines which parameter is displayed. This multiplexer is constructed by combining the outputs of two gates of analog switch U28 and connecting the combined output to the input of the A/D converter, U26.

The input to on-gate, U28D-8, is the temperature data from the bridge amplifier, U49-1, whose schematic name is AMONT.

The input to the other gate, U28A-2, is the setpoint voltage from the output of the digital/analog (D/A) converter, U46B-7, whose schematic name is VSET.

The outputs of the read/set logic contained in the programmable logic chip, U44, determines the control of these gates.

The A/D converter, U26, is a CA3162 that combines the A/D function with a multiplexed display driver output. Because the A/D converter only operates for input voltage from 0 mV to 99 mV, the input voltage to the A/D converter is attenuated by a factor of 10 through the resistor divider combination of R69 and R70. The capacitor C38 filters the A/D converter voltage for stable display readings.

The A/D converter presents BCD information to the seven-segment decoder/driver, U27, which drives the temperature displays, DS13 through DS15. The digital-strobe output, U26-3 through -5, of the A/D converter through drive transistors, Q18 through Q20, drive the anodes of the display.

The analog switch, U36, provides the display lamp test function during the Auto-Test cycle at power-up.

For calibrating the A/D converter, the potentiometer, RT12, controls the zero, and RT11 controls the gain.

Pin 6 of the A/D converter is the “hold” input which, if biased properly, holds the display reading of the last converted number. Diodes D1 and D2 provide this 1.2V bias voltage. The NOR gate signal, U5A-3, provides control over the “hold” mode. This input eliminates display flickering when the temperature is at a transition point. The output U5A-3 is normally high, keeping the A/D converter in the “hold” mode. Every few seconds, a pulse goes through C17, which forces U5A-3 low and updates the A/D converter’s temperature information. The C17 and R20 time constant determines the duration of this pulse.

When the display indicates the setpoint temperature, this “hold” mode must be overridden to provide a fast response during the temperature setting operation.

During the setpoint mode, the components D17, R48, and C16 control the “hold” input. When the setpoint temperature is displayed, the anode of D17 goes high, forcing U5A-3 low. This puts the A/D converter into Fast-Conversion Mode to allow the setting of the temperature. R18 and C16 provide a delay after the anode of D17 goes low again. This delay keeps U5A-3 low long enough to allow for the analog switches to settle and the A/D converter to convert the hood temperature and display it. This is preferred rather than holding the control temperature on the display for a few seconds before the hood temperature is again displayed.

Offset

To compensate for temperature gradients between the sensor’s location and the mattress center, the air temperature displayed on the front panel is calibrated with a 1.5°C offset. The temperature of the mattress center is 1.5°C higher than the temperature at the tip of the air probe. Therefore, the resistance corresponding to 34.5°C (94.1°F) is placed in the air monitor probe, and the display is then calibrated to 36.0°C (96.8°F).

Setpoint Circuitry

Read/Set Control Latch

The read/set logic, U44, selects the temperature shown on the digital display. In its normal state, the latch selects the hood temperature displayed by keeping U44-16 high. The control temperature is displayed on demand either during the Auto-Test cycle or by pressing the **Set Temp** switch, S4.

The control temperature is displayed until a low level at U44-8, RX2, resets the latch. This happens at power-up through the RESET signal at U5C-8 and by the other input, U5B-4, when it goes high approximately 14 seconds after you press the **Set Temp** switch, S4, or when the switches S2 or S3 are released.

Setpoint Voltage

The output of the temperature setpoint circuit is biased to provide the same output range as the bridge amplifier.

This voltage establishes the reference temperature for the temperature control circuitry.

Two functional blocks make up the main part of this circuit:

- The presettable up/down counter, U30, U31, and U37A
- The D/A converter, RN3, U48A, and U48B

The **Set Temp** switch, S4, and the increase and decrease switches, S2 and S3, provide control over this circuit. These switches work in conjunction with the control and limit circuitry, U44, to establish the incubator's control temperature.

The R/2R ladder network, RN3, converts the binary output of the presettable up/down counter to an analog voltage. U48A buffers the output of the ladder network so as not to load the relatively high impedance output of RN3. The voltage at U48-1 ranges from 0V to 5V for counter outputs of binary 0 to binary 512. U30 and U31 form an 8-bit binary counter. Flip-flop U37A adds a ninth bit for better resolution. These nine bits give the following resolution:

$$Resolution = \frac{TMAX - TmrN}{2^9}$$

$$Resolution = \frac{40° - 20(40)°}{512}$$

$$Resolution = \frac{0.39°C}{BIT}$$

Since the resolution of the temperature display is only 0.1°C, this is an adequate resolution.

To be compatible with the bridge amplifier output, the 0V to 5V output voltage of the D/A converter must convert to a 2V to 4V range. This is done using amplifier U48B as a non-inverting sining amplifier that adds a DC bias voltage to the D/A converter output to obtain the desired output voltage range. RT3 is adjusted to provide a nominal 1.25V at the junction of RT3 and R79.

The incubator is set to 36.0°C (96.8°F) at power-up by a pulse on U30-1, U31-1, and U37A-6. This sets the counter outputs to a a predetermined state equivalent to a 36.0°C (96.8°F) setpoint temperature. R72 and C35 form a "de-glitching" filter to guard against a spurious "carry-out" signal from the U31 counter. The output NENI, U44-91, provides control over the counter. The 9 Hz nominal clock to the counters is always running. NENI is normally high, disabling the counters. The following three logic circuits, all contained in PAL U44, control NENI:

- Read/set latch output
- Increase/decrease switches
- Limit circuit output

All three inputs must be high in order to enable the counters. Thus, pressing either increase or decrease switch does not change the setpoint temperature unless the read/set latch is set by pressing the **Set Temp** switch, S4, first. For the case where the assume limit circuit output is high, operate the setpoint as follows:

1. Change the setpoint temperature by pressing the **Set Temp** switch, S4. A timer begins, the **Setpoint** indicator, DS6, lights, and the **Air Temperature** display shows the setpoint temperature.

2. The timer times out, and the display automatically reverts to indicating the hood temperature after about 15 seconds.

3. If, after pressing S4, you want to change the setpoint temperature, press either S2 or S3, and hold until the desired setpoint temperature is indicated on the display.

4. If reaching the desired temperature takes longer than the 15-second automatic time out, the logic in U44 "locks out" the time-out pulse and maintains the display in the setpoint mode until the increase or decrease switch is released.

Signal UPND, U44-22, U30-10, and U31-10, determines the up or down direction of the counters. The endpoint limit circuitry is contained in U44. This is required to provide high and low temperature setpoint limits and keep the counter from "rolling over" when the maximum and minimum counts are reached.

The comparators U42-A and U42-B monitor the D/A converter output voltage at U48-A. RT2 is set to obtain a maximum control temperature limit of 38.0°C (100.4°F) while the voltage at U48B-8 is chosen to provide a minimum setpoint of about 22.0°C (71.6°F). When either of these extremes is reached, logic in U44 goes active, disabling the counter through NTENI. The signals L1 and L2 internal to U44 force the state so that if a limit is reached, the direction of the count may reverse.

The 38.9°C (102.0°F) ± 0.5°C limit may be overridden to perform an incubator high temperature ring-out test by pressing the **Set Temp** switch, releasing it, and then pressing the increase and decrease switches simultaneously, so a setpoint temperature of 40°C (104°F) is achieved. The setpoint rolls over at 40°C (104°F).

Air-Temperature-Controlling Circuitry

Probe

The probe is a dual-thermistor type. Both thermistors are identical. One is used for monitoring, and the other for controlling.

For air temperature control, the other sensor in the air temperature probe is used. Sensor 2TR1-b of the dual-thermistor probe measures the incubator hood temperature and forms parts of a bridge circuit consisting of R60, R61, R124, R127, and RT8.

Amplifier

The bridge amplifier, U49B, amplifies the bridge output voltage. This amplifier provides the gain and linearization for the thermistor probe's output. The nominal range of output voltage is 2V AC to 4V AC for a 20°C (68°F) to 40°C (104°F) temperature range. This corresponds to a sensitivity of 100 mV/°C.

Error Amplifier

Temperature information from the probe amplifier, U49B-7, is presented to one input of differential amplifier, U47A. This amplifier compares the probe temperature information with the temperature reference voltage from the setpoint temperature circuitry. The output of the differential amplifier is a voltage proportioned by the difference between the measured temperature and the setpoint temperature reference. The gain of 50 provides an output sensitivity of 5V/°C.

The output from this amplifier provides the input to the power control circuit and the **Heater** power indicator circuitry.

Power Heater Control Circuit

The 5V/°C output sensitivity, VERR, from the differential amplifier, U47A-1, provides the input for the power control circuit at U2-5. This circuit consists of a 555 timer configured as a pulse-width modulator that provides an output duty cycle proportional to the voltage at its input. Components R114 through R117 and Q22 form a constant current source to charge the capacitor C42 linearly. This provides an output duty cycle that is linearly proportional to the input control voltage. The U33 output, pin 3, is set high by the trigger pulse occurring approximately every 160 milliseconds at U33-2. The output remains high until the voltage at U33-6 equals the control voltage at U33-5. At that time, U33-3 goes low, and C42 discharges. The output stays low until the trigger pulse at U33-2 forces it high again. When the output is high, the heater energizes.

Resistor R117 provides an offset at U33-6, preventing pin 6 from going to ground potential when C42 discharges. This allows a lower minimum duty cycle than if R117 was not used.

TRGP-U6D-11 provides trigger pulses and provides a means to shut down the heater power if the **High Temp** alarm activates. When the **High Temp** alarm activates, U6D-11 goes high and holds U33-2 and -4 low. This keeps the output in the low state and disables the heater.

The **High Temp** and **Heater Temp** alarms set HDSBL, U15-22, low, shuts off the relay K3 on the power P.C. board, and removes power from the heater.

Clock and Timing Circuitry

The fundamental clock for all timing is the 150 Hz Complementary Metal-Oxide Semiconductor (CMOS) clock composed of U7C, U7D, RT1, R5, and C10. This clock supplies the input to the clock divider circuit, U3. All delay and timing signals derive from either the 150 Hz nominal clock oscillator or the divider U3.

U3 provides the following:

- 9.4 Hz frequency that increments the setpoint temperature up/down counters, provides trigger pulses to the power control, and modulates the **High Temp** and **Heater Temp** audible alarms
- 2.4 Hz signal used with a 14-second period output that terminates the Auto-Test, provides the alarm delay, and enables the **Sensor** and **Low DC** audible alarms
- 1.2 Hz signal to enable the alarm flash and tone
- 0.3 Hz signal to update the A/D converter every 3½ seconds
- 28-second period clock for the alarm silence circuit
- U12B and U11B that form a latch acting as a 14 second mono-stable to reset the setpoint latch in U44

When an alarm condition occurs, the clock divider, U3, resets so the delay for the alarm's clock signal delay is a low transition at U5D-11. This creates a reset pulse, RST, at U11A-9 until the RC circuit of C12, R9, and R10 charges. When U3-15, SECT, goes high after 7 seconds, U8A generates a 0.4-second low pulse that clocks U9B through U12C, providing a clock pulse to the alarm latches in U44.

The **Setpoint Temperature** display cycle also initiates a counter reset. Pressing the **Set Temp** switch, S4, sets the U44-16, NSETP, low, causing the clock divider, U3, to reset through U11A-9, RST. The counter cycles through until U3-1 goes high after 14 seconds, resetting the read/set latch in U44 through U12B and U11B. During the 14-second cycle, the **Setpoint** indicator illuminates, and the display shows the temperature setpoint.

Alarms

The following alarms are provided:

- The **High Temp** alarm indicates over-temperature conditions within the hood.
- The **Heater Temp** alarm indicates over-temperature conditions within the heater.
- The **Sensor** alarm indicates an open- or short-circuited safety sensor, a shorted skin temperature sensor, or a shorted **Air Temperature** display sensor.
- The **Low DC** alarm indicates a low battery or low external DC voltage.
- The **Airflow** alarm indicates a blocked or missing impeller.
- The **Power Failure** alarm indicates the loss of incubator power or of all power.

High Temp

If the incubator hood temperature exceeds 38.9°C (102.0°F) ± 0.5°C, a **High Temp** alarm occurs. The comparator, U34A, detects **High Temp** alarm conditions, and RT7 sets them. When the temperature rises above 38.9°C (102.0°F) ± 0.5°C, the voltage at U34A-5 becomes higher than U34A-4, so U34A-2 goes to 5V. U17E-1, U17E-10, and U39A-1 go high. If no **Temp Probe** alarm is active, U39A-3, HITEMP, goes high. This signal connects to the alarm PAL, U13, which drives the **High Temp** indicator DS1 through U20B. This signal is gated with a 1.2 Hz signal to flash the alarm indicator.

Heater Temp

A **Heater Temp** alarm occurs under the following two conditions:

- The heater is disconnected, or the heater temperature cutout switch activates.
- The heater driver circuitry is not working properly.

If the heater becomes disconnected, signal NOHEAT goes low. Through the inverter circuit, Q14, R66, R55, and R57, the signal OVRH goes high at pin 9 of U15. The logic in U15 then sets pin 20, NHTRT, low. This signal connects to U13, and a low activates the **Heater Temp** alarm.

If the heater driver circuitry is not working properly, the logic is more complicated. The logic in U15 looks at both the heater driver control signal, DHC7RL, and a feedback signal, HFB, from the power P.C. board driver

circuit. If the two signals are inverted and in phase, the heater is assumed to operate properly, and no alarm is generated. If some problem exists in the heater drive circuit, the two signals become out of phase, generating an error signal at U15-14. R200 and C66 filter this signal, and it is fed back into U15-15. If this signal goes high, signal NHTRT goes low, and the **Heater Temp** alarm activates.

DHCTRL is the normal heater control signal, HCTRL, reduced by the R198, R199 divider to keep it from exceeding the U15 input voltage limit.

The **Heater Temp** alarm cannot be cleared; however, it may be silenced by pressing the **Silence/Reset** key. The **Controller** switch must be pressed, and the fault must be corrected.

Sensor

If the air temperature sensor opens or shorts, or if the skin sensor shorts, the **Sensor** alarm is generated. The steering diodes, CRA1A through CRA1E, and the window comparator, composed of the comparators U34B and U34C and their associated circuitry, accomplish this. Information about the state of the probes is obtained from the output of their respective bridge amplifiers and, in effect, wire OR'ed through the diodes CRA1A through CRA1E. If a sensor is shorted, its bridge output goes high. This causes the comparator, U34B, pin 1, to go low, and, through inversions in U17F, U39B, and U17D, the signal SENSOR goes high. This signal connects to the alarm logic PAL, U13, where a high generates a **Sensor** alarm. A similar situation occurs when a sensor is open, except that the comparator, U34C, goes low. This alarm may be silenced for 5 minutes by pressing the **Silence/Reset** key, but the alarm cannot be cleared until the fault is corrected. The alarm sounds about 0.5 seconds every 14 seconds.

Low DC

If the unit operates from either an external DC power source or a battery, and the voltage goes below 10.5V DC or, for the 28V model, 25.5V DC, the **Low DC** alarm occurs. A dual set of window comparators, U43A and U43B for 28V or U34C and U34D for 12V, detects this low DC. The outputs of these comparators are wire OR'ed, and the combined outputs of each is diode OR'ed by D4 and D5 to generate the signal NLODC. This signal connects to the alarm PAL U13. Under normal operation, the outputs of the comparators are high, and hence NLODC is high. If a voltage goes out of its range, NLODC goes low, and U13 flashes the sensor alarm LED, DS2, and sounds the alarm. The alarm sounds about 0.5 seconds every 14 seconds.

Airflow

An **Airflow** alarm occurs in the following two cases:

- The fan motor impeller is missing or free-floating on the motor shaft
- The fan motor impeller is obstructed and cannot rotate.

The airflow circuit cannot detect an obstruction in the airflow path unless it blocks the spinning of the impeller.

The detection circuit consists of a motor current sense resistor on the power P.C. board, an integrator amplifier, U47B, and a window comparator, U42C and U42D. A one Ω resistor is placed on the power P.C. board in series with the fan motor. The voltage on this resistor is proportional to the current in the motor. Under normal operating conditions, a small AC signal appears across the resistor. U47B amplifies this signal, converts it to DC, and then feeds it to the input of the window comparators, U42C and U42D. Under normal operating conditions, the voltage is within the range, and the output of the comparators, signal NAFLOW, is high.

If the motor impeller is missing, the current in the sense resistor decreases as does the voltage into the comparators. This puts the input to the comparators out of the window, and U42D pulls NAFLOW low. NAFLOW connects to the input of the alarm PAL, U13, and, hence, the indicator DS11 flashes, and an alarm sounds.

If the impeller is blocked, the current through the sense resistor increases. In this case, U42C-14 goes low, and the alarm circuits activate. To silence this alarm for 5 minutes, press the **Alarm/Silence** key; however, it cannot be cleared until the fault is corrected.

Power Failure

The **Power Failure** alarm has two distinct modes of operation:

- If the unit is in the operating mode and all power sources fail or are not present, an alarm activates. This alarm is a continuous indicator light and a continuous audible alarm. To silence this alarm, press the **Standby** switch.
- If the power source is changed from AC or an external DC to a battery while the unit is operating, an alarm activates. This alarm is an intermittent light and sound. To clear this alarm, press the **Silence/Reset** key.

In the first failure mode, the alarm circuitry consists of Q1, R2, R29, D9, and D10. Q3 acts as a comparator, and compares its base voltage to its emitter voltage. When the incubator power, AC, DC, or battery, is present, the **Power**

Failure alarm battery, connected at J1, charges through the resistor R29 and the diodes D9 and D10. The relay K1 connects R2 to ground through the pins 7 and 8, and provides a base current for Q1 in the event of a power failure. If the incubator power fails, D10 becomes reversed-biased, and R2 turns on Q1. Q1's collector then provides the supply voltage, V1, to the audible alarm, and lights the **Power Failure** indicator, DS5. The audible alarm energizes due to the disappearance of the +5V logic power supply. To silence the **Power Failure** alarm, press the controller's **Standby** switch, S7, to reset the power latch and turn off Q1 through R2.

In the second failure mode, the signals NACON and NVEDC going into U14 monitor the state of the AC mains and the external DC. The logic internal to U14 monitors these two signals, and when both are inactive, the output U14-15 makes a positive transition from low to high, clocking a high into the flip-flop U9A, and setting its output, PLOSS, to a high. This signal connects to the input of alarm PAL, U13, and when high, it activates the **Power Loss** alarm circuit. The output NPFAO, U13-19, goes low, setting the signal NPFA low through U2B-5. This signal pulls the R29/D10 junction to the ground, and removes the reverse-bias from the transistor, Q1. Q1 turns on through R2 and powers the indicator, DS5. The audible alarm enables through U13-21 and U13-22. To reset this alarm, press the **Silence/Reset** key.

Logic Circuits for the Alarms

The following four programmable logic integrated circuits contain most of the logic of the controller P.C. board:

- U44
- U13
- U14
- U15

Clock

The programmable logic chip, U13, contains most of the alarm logic.

If any alarm condition occurs, the condition latches into an internal register of U13. However, the alarm condition is not passed to the alarm latches until U13's register clock, pin 1, goes high. The circuit containing U9, U12A, U12C, and U11C derives the clock signal. The U13 clock signal comes from the Q output, pin 13 of the D flip-flop, U9B. Under normal conditions, the reset of this register is held active, thus preventing spurious alarm clock signals. When an alarm condition occurs, the ALARM signal at U12A-1 goes high, releasing the reset of U9B, allowing the clock signals to generate. This

happens about 7 seconds after an alarm occurs because the clock signal L14SEC, which is a pulse, occurs every 7 seconds. Due to the momentary alarm level transitions, this guards against false alarms. If the alarm condition clears before the 7-second time period, U12A-3 goes high again, and no alarm sounds. This alarm delay is bypassed during the Auto-Test cycle. Alarms may be cleared in different manners, depending on the alarm.

Logic

If the alarm condition is still present after the delay, the appropriate alarm latch of U13 activates, and thus enables the corresponding alarm output of U13, the corresponding indicator driver of either U2, U20, U21, or U22 and its associated indicators, DS1 through DS4 and DS11. The alarm indicator drive signal is gated with a square-wave from the clock circuitry to flash the indicators at a 1.2 Hz frequency. Information concerning the type of alarm passes on to the appropriate alarm indicator.

Alarm Indicators

There are the following six bar-type LED indicators, one for each of the alarms:

- **High Temp** alarm—DS1
- **Heater Temp** alarm—DS3
- **Sensor** alarm—DS2
- **Low DC** alarm—DS4
- **Airflow** alarm—DS11
- **Power Failure** alarm—DS5

Audible Output

The audible alarm circuit consists of U4, D15, D16, R54, and DS12. This circuit comprises the free-running oscillator whose output drives a buzzer, DS12. Transistor Q3's collector controls the state of the oscillator. When it is low, the oscillator is off, and there is no drive to the buzzer. When it is high, the oscillator runs, the drive to the buzzer enables, and the tone sounds. The basic drive signal NBUZZ controls the state of the Q3 collector. The NBUZZ signal is an output from the buzzer control PAL, U15. During the Auto-Test function, the alarm is disabled.

The audible alarm also enables momentarily when the **Set Temp** switch, S3, is pressed, alerting the user that the setpoint temperature is being displayed on the

digital display. This is done on the leading edge of the read/set latch transition to U44. The alarm enables for about 53 milliseconds.

Alarm Silence and Reset

Switch S5 performs both the alarm reset and the alarm silence functions. The logic for the alarm function is contained in PAL, U44. The alarm latches reset after the Auto-Test cycle and at power-up. If the alarm condition is cleared, the latches reset when S5 is pressed. If the alarm condition still exists, the reset occurs. However, if the alarm condition is either the **Sensor**, **Low DC**, or **Airflow** alarm, it may be silenced for about 5 minutes through the alarm silence circuitry in PAL, U14. The timer is non-resettable, and it cannot reactivate until the 5-minute time period elapses.

The timer is held disabled as long as no alarm is present, and enables when an alarm occurs.

Auto-Test Function

The Auto-Test cycle begins when power is first applied to the control panel. For the Auto-Test cycle, refer to table 3-1 on page 3-27.

Table 3-1. Auto-Test Cycle

Function	Duration	Visual
Alarm/lamp test	7 seconds	“88.8” appears on all displays, and all indicators light.
Setpoint display	14 seconds	An alarm sounds momentarily, the **Setpoint** indicator lights, and the set-point appears on the **Air Temperature** display.
The **Air Temperature** and **Skin Temperature** displays	Continuous	The **Setpoint** indicator is off, and the air temperature and the skin temperature appear on their respective displays.

C9, R3, U7A, and U7B provide a power-up signal. This power-up pulse initiates the following functions:

- Through U15, it prevents the **High Temp** alarm from blanking the **Heater Power** indicator.
- It lights all of the **Heater Power** indicators.
- It disables the audible alarm through R110.
- It activates U13 through U15 and Q24, providing the alarm test functions at power-up.

When U3-15 goes high after about 7 seconds, the Auto-Test latch resets through U8A. When this occurs, the **Alarm Test** switches disable, and the mono-stable in U44 is triggered. The logic in U44 sets the read/set latch to Set Mode, enabling DS6, and displaying the 36.0°C (96.8°F) nominal power-up temperature setpoint on the **Temperature** display.

The U44-16 output, NSETP, provides a reset signal to the counter, U3, through U11A. The alarm latches reset through U13.

The read/set latch remains in this state until U11B-6 goes low in about 14 seconds, resetting the latch through U5C-10. When this occurs, the Auto-Test cycle completes, and the **Temperature** display reverts to normal operation, indicating the hood temperature.

During the Auto-Test cycle, the analog switches, U28, the transistors, Q2 and Q24, and the integrated circuits, U13 through U15 and U44, test the alarm circuitry. When three circuits enable during the Auto-Test function, they simulate the alarm conditions and activate all alarm circuits.

Chapter 4
Removal, Replacement, and Adjustment Procedures

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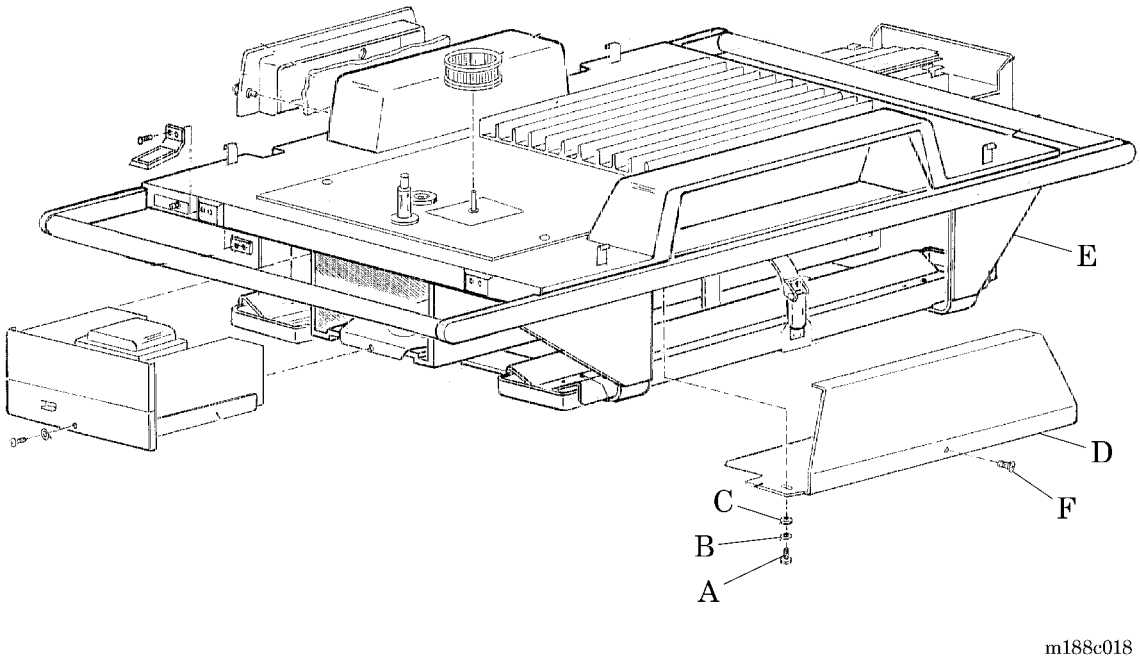
4.1 Control Panel Assembly

Tools required: Phillips head screwdriver

Removal

1. Using a phillips head screwdriver, remove the two screws (A), lockwashers (B), and flat washers (C) that secure the control panel assembly (D) to the underside of the base assembly (E) (see figure 4-1 on page 4-3).

Figure 4-1. Control Panel Assembly



2. Support the control panel assembly (D) with one hand, and use a phillips head screwdriver to remove the screw (F) that secures it to the front of the base assembly (E).

3. Remove the control panel assembly (D) from the base assembly (E).

Replacement

1. Perform the removal procedure in reverse order.

2. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

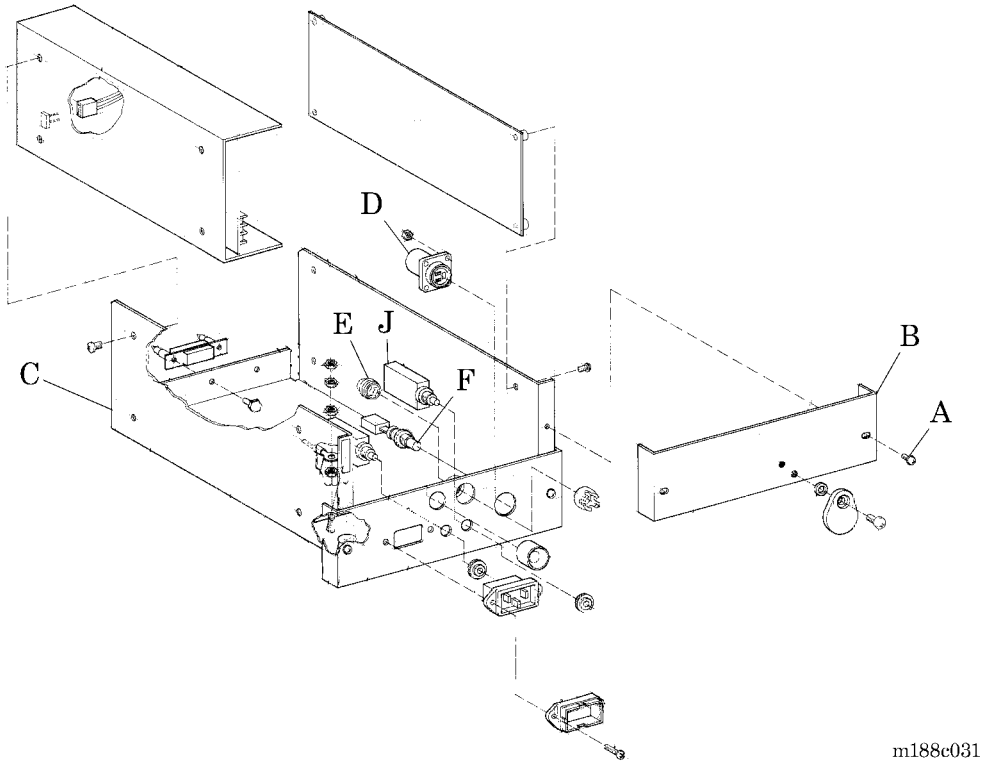
4.2 Power Chassis

Tools required: Phillips head screwdriver

Removal

1. Using a phillips head screwdriver, remove the two screws (A) that secure the front upper plate (B) to the power chassis (C) (see figure 4-2 on page 4-4).

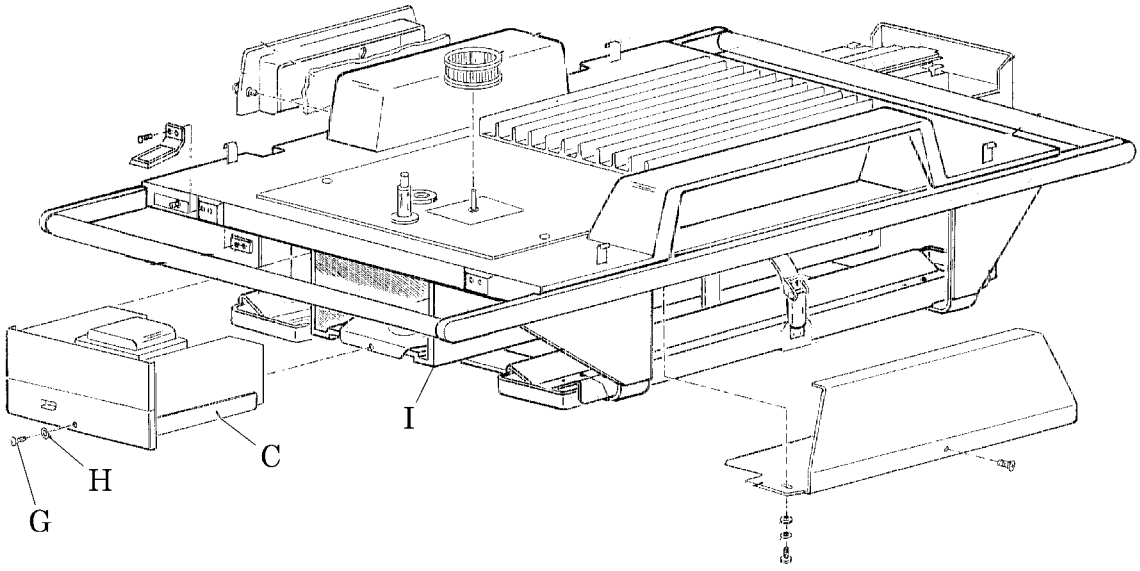
Figure 4-2. Power Chassis Front Upper Plate



2. Disconnect the external DC cable assembly (D), the skin probe cable assembly (E), the power switch cable assembly (F), and the two circuit breakers (J) located behind the front upper plate (B).

3. Using a phillips head screwdriver, remove the screw (G) and the spiral lockwasher (H) from the bottom center of the power chassis (C) (see figure 4-3 on page 4-5).

Figure 4-3. Power Chassis



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4. Slide the power chassis (C) out of the incubator (I).

Replacement

1. Perform the removal procedure in reverse order.

2. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

4.3 Battery Tray

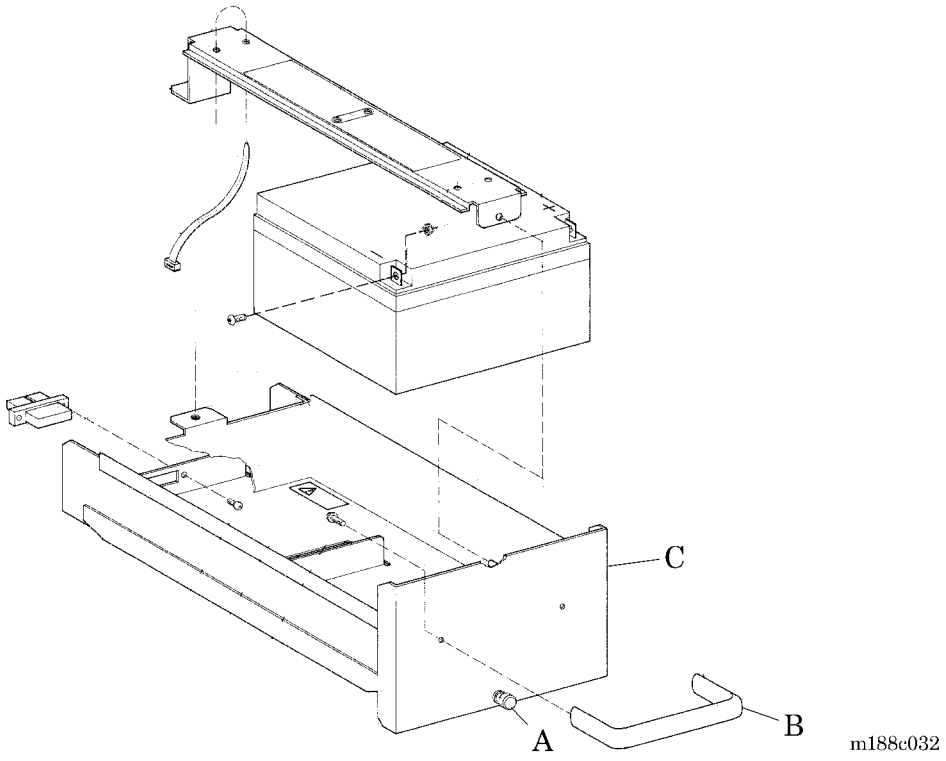
Tools required: None

Removal

SHOCK HAZARD:
To prevent damage to the equipment, remove all power from the unit. Failure to do so could result in personal injury or equipment damage.

1. Set the **Power** switch on the power chassis to the Off-0 position.
2. Set the **Standby** key on the control panel assembly to Off.
3. Unplug the unit from its power source.
4. Completely loosen the retaining screw (A) (see figure 4-4 on page 4-6).

Figure 4-4. Battery Tray

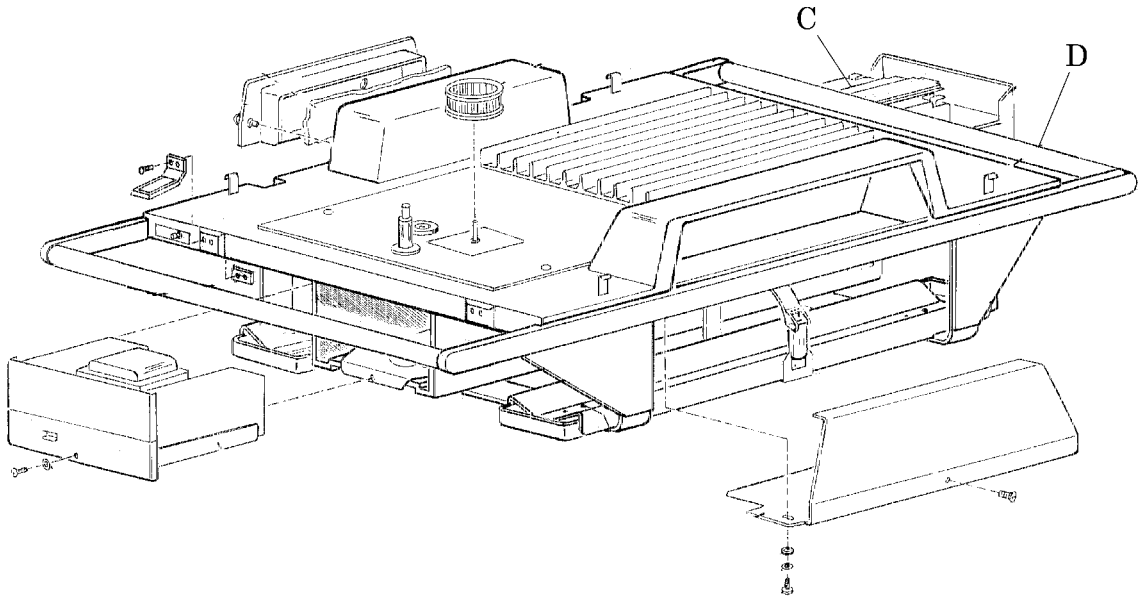


5. Grasp the handle (B), and **very** slowly pull the battery tray (C) out approximately 15 cm (6").

WARNING:
During removal and replacement, support the battery tray, and avoid pinch points. Failure to do so could result in personal injury or equipment damage.

6. Position a hand on each side of the battery tray (C) as close as possible to the incubator (D) (see figure 4-5 on page 4-7).

Figure 4-5. Transport Incubator



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7. Slowly remove the battery tray (C) from the incubator (D).

NOTE:
With two batteries installed, the battery tray weighs approximately 22.7 kg (50.0 lb).

8. Place the battery tray (C) on a surface that supports its weight.

Replacement

1. Perform the removal procedure in reverse order.

2. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

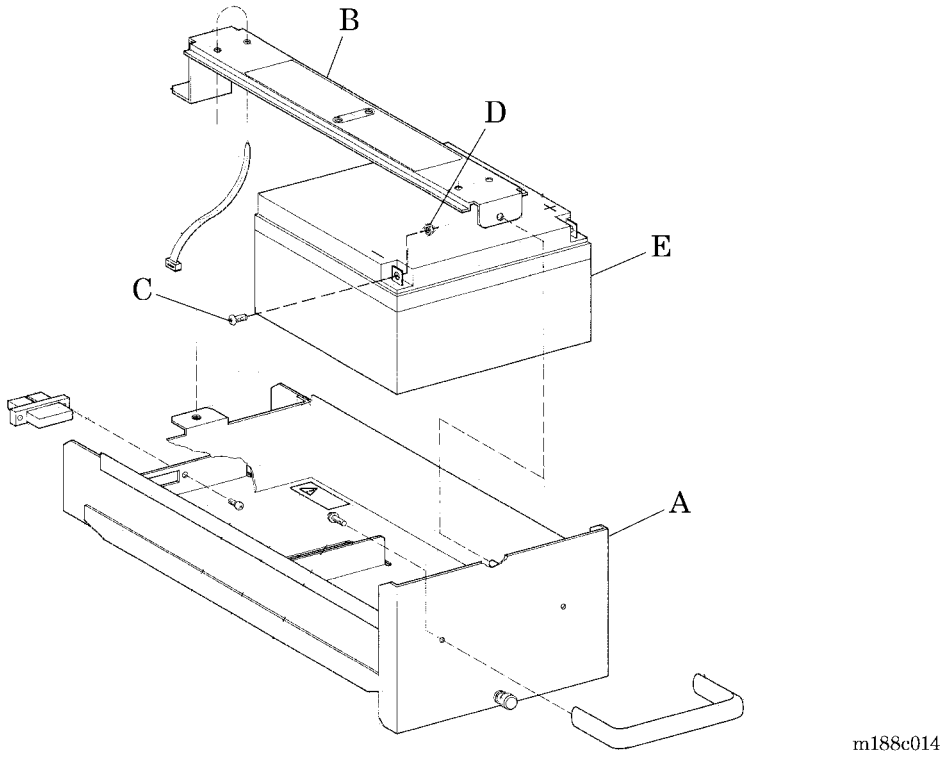
4.4 Battery

Tools required: Phillips head screwdriver

Removal

1. Remove the battery tray (A) (refer to procedure 4.3) (see figure 4-6 on page 4-9).

Figure 4-6. Battery



2. Loosen the retaining thumbscrew that secures the battery clamp (B) to the battery tray (A).

3. Raise the rear end of the battery clamp (B) until it unhooks from the front of the battery tray (A).

4. Using the phillips head screwdriver, remove the two screws (C) and hex nuts (D) that secure the red and black leads to the battery (E).

5. Disconnect the red and black leads from the battery (E).

6. Remove the battery (E) from the battery tray (A).

Replacement

1. Perform the removal procedure in reverse order.

2. Perform the maintenance procedure for the battery (F) (refer to procedure 6.3)

3. To ensure proper operation of the Transport Incubator, perform the “Function Checks and General Operation Checkout” on page 2-4.

4.5 Heater Assembly

Tools required: Phillips head screwdriver

Removal

1. Remove the hood (A) and upper shell (B) from the incubator (C) (see figure 4-7 on page 4-12).
2. Remove the control panel assembly (D) (refer to procedure 4.1).
3. Remove the power chassis (E) (refer to procedure 4.2).
4. Using a phillips head screwdriver, remove the two ¾" screws (F), 5/8" screws (G), lockwashers (H), and flat washers (I) that secure the heater assembly (J) to the tank support (K) and base molding (L) (see figure 4-8 on page 4-13).
5. Remove the heater assembly (J) from the incubator (C) (see figure 4-7 on page 4-12).

Replacement

1. Perform the removal procedure in reverse order.
2. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

Figure 4-7. Transport Incubator

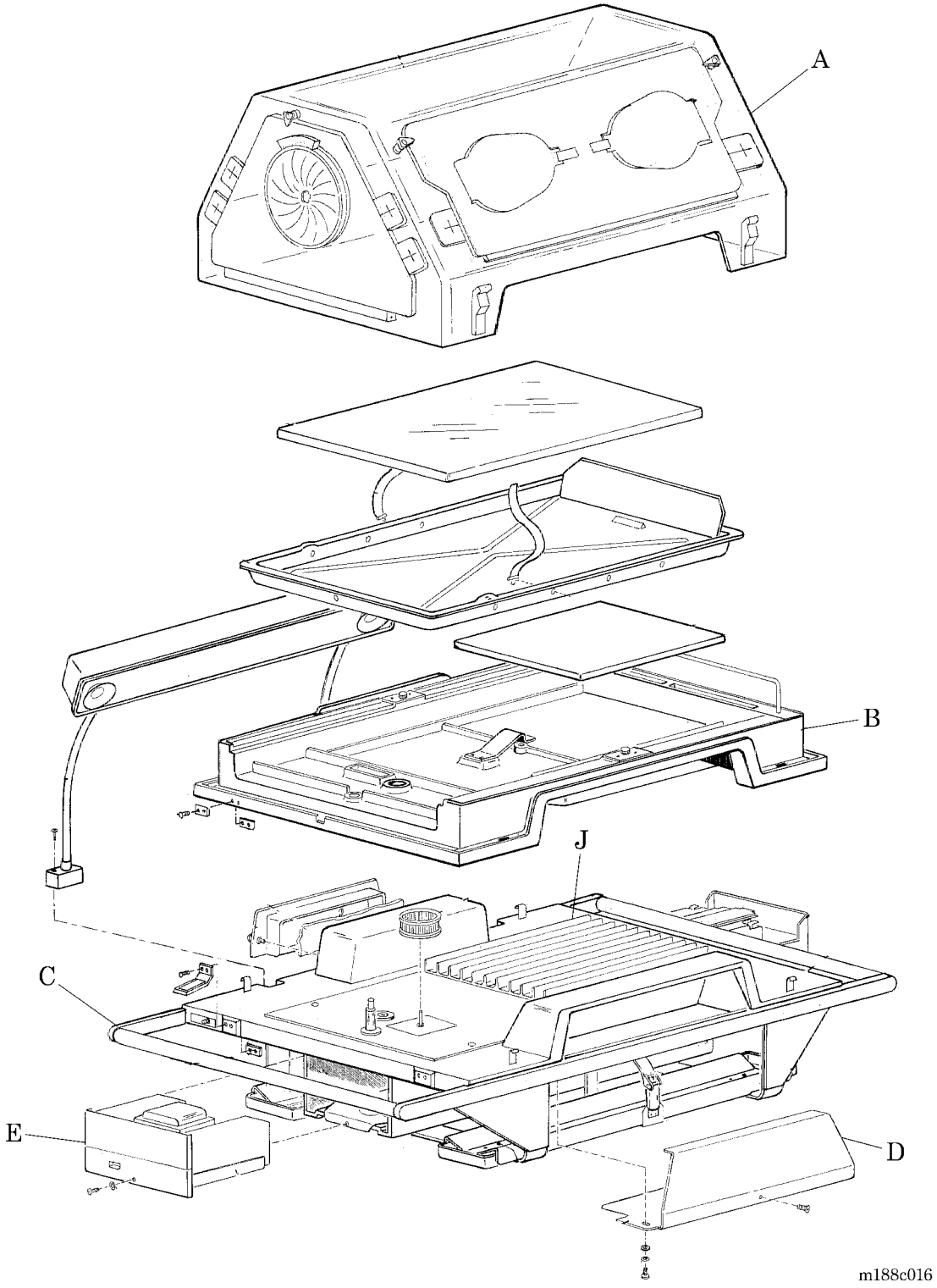
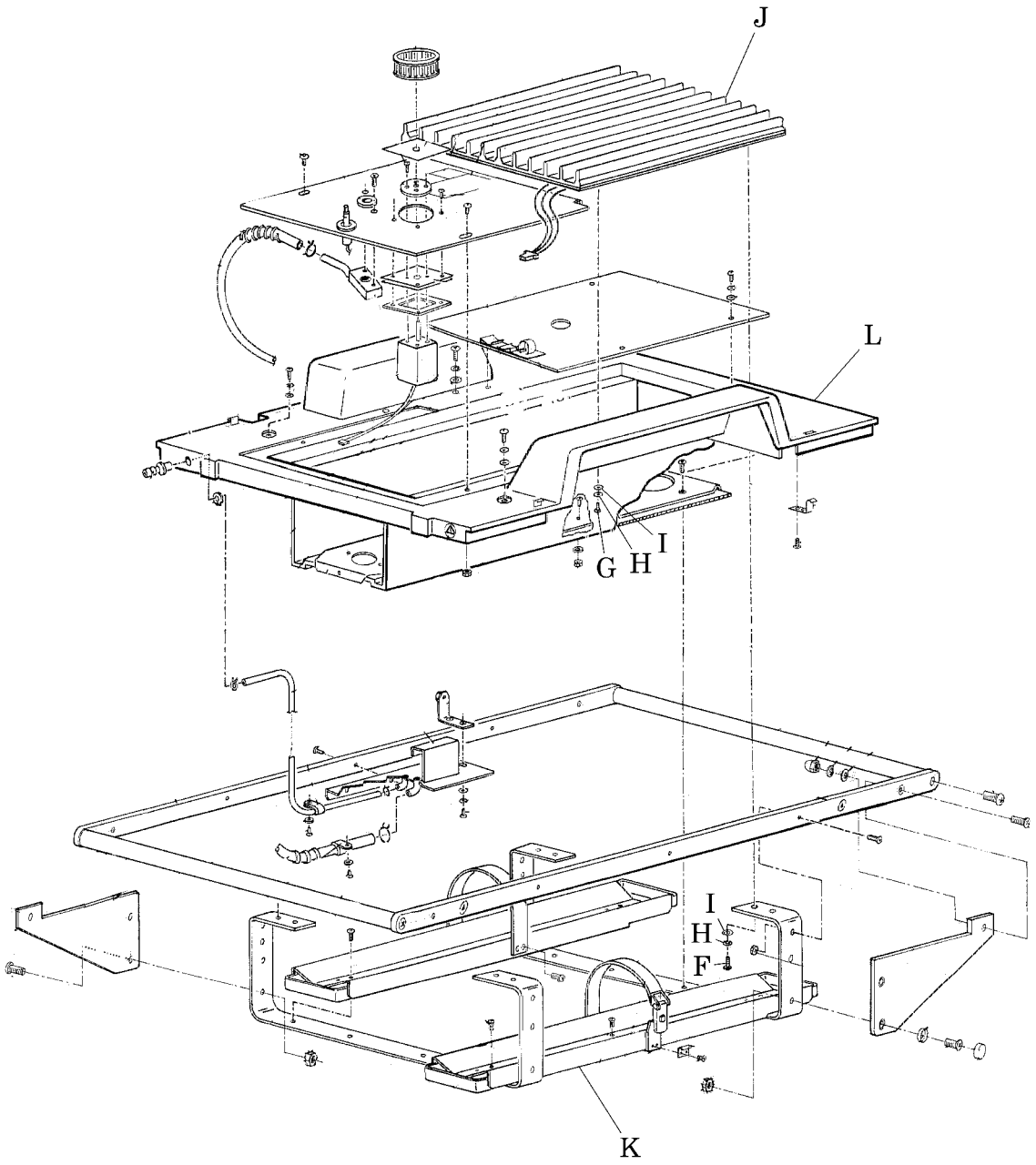


Figure 4-8. Heater Assembly



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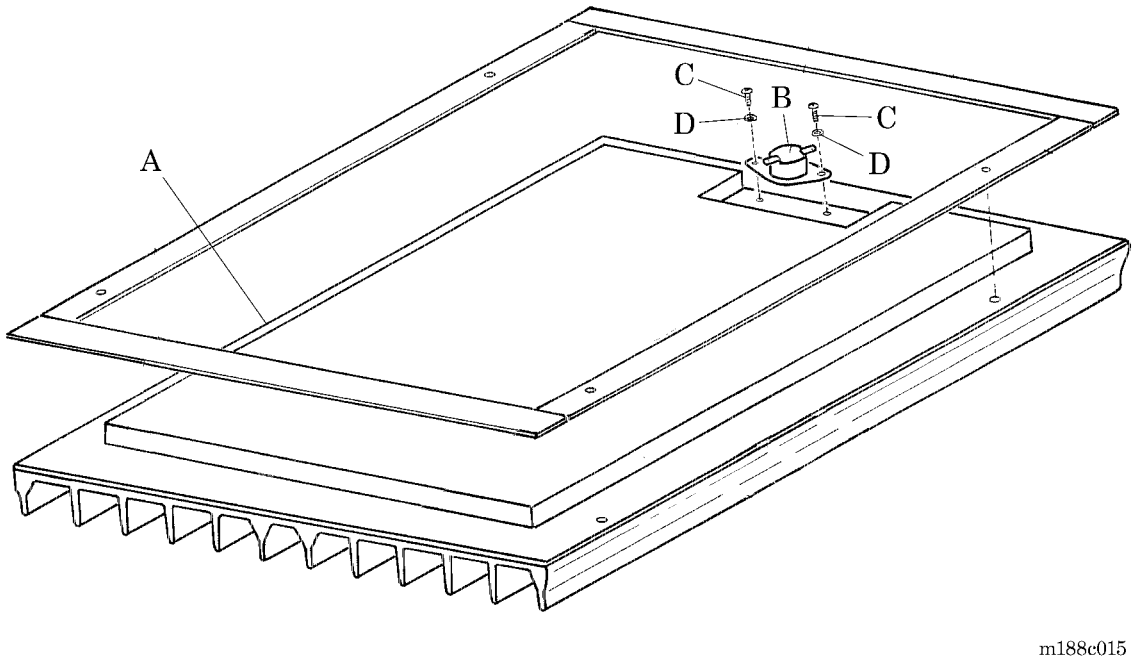
4.6 Thermostat

Tools required: Phillips head screwdriver

Removal

1. Remove the heater assembly (A) (refer to procedure 4.5) (see figure 4-9 on page 4-14).

Figure 4-9. Thermostat



2. Disconnect the wires from the thermostat (B).

3. Using a phillips head screwdriver, remove the two screws (C) and lockwashers (D) that secure the thermostat (B) to the heater assembly (A).

4. Remove the thermostat (B) from the heater assembly (A).

Replacement

1. Perform the removal procedure in reverse order.

2. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

4.7 Fan Motor

Tools required: Screwdriver

Removal

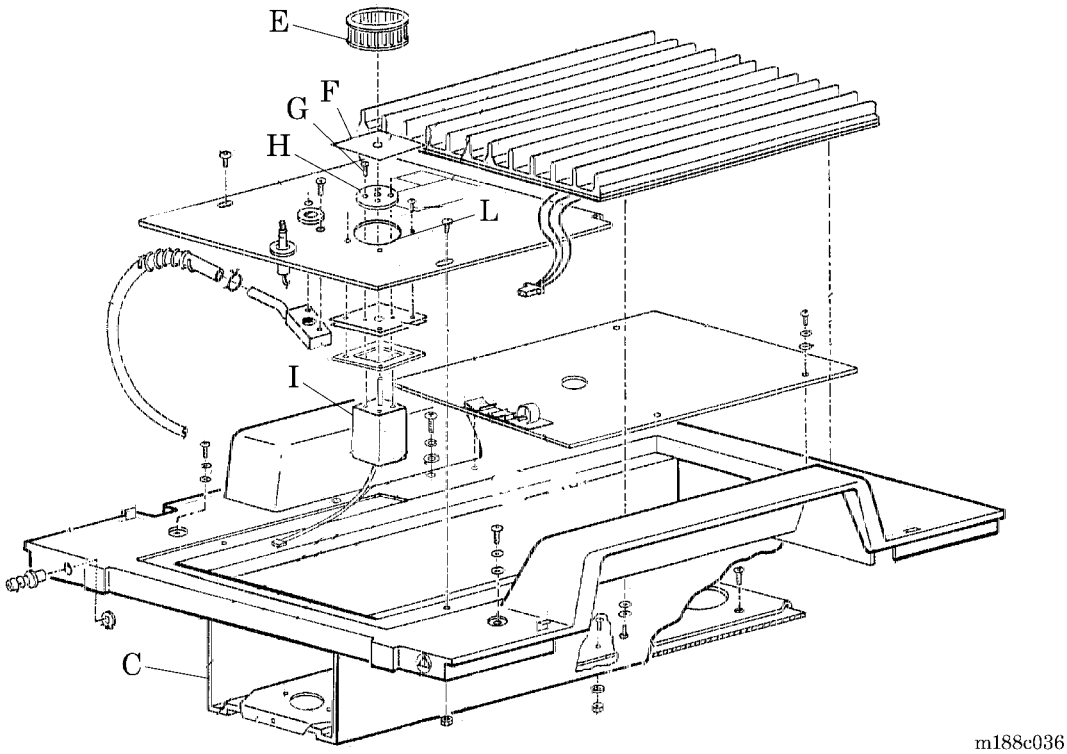
1. Remove the hood (A) and upper shell (B) from the base assembly (C) (see figure 4-11 on page 4-16).

2. Remove the power chassis (D) (refer to procedure 4.2).

3. Remove the impeller (E).

4. Remove the adhesive-backed, motor, dust cover (F), and discard (see figure 4-10 on page 4-15).

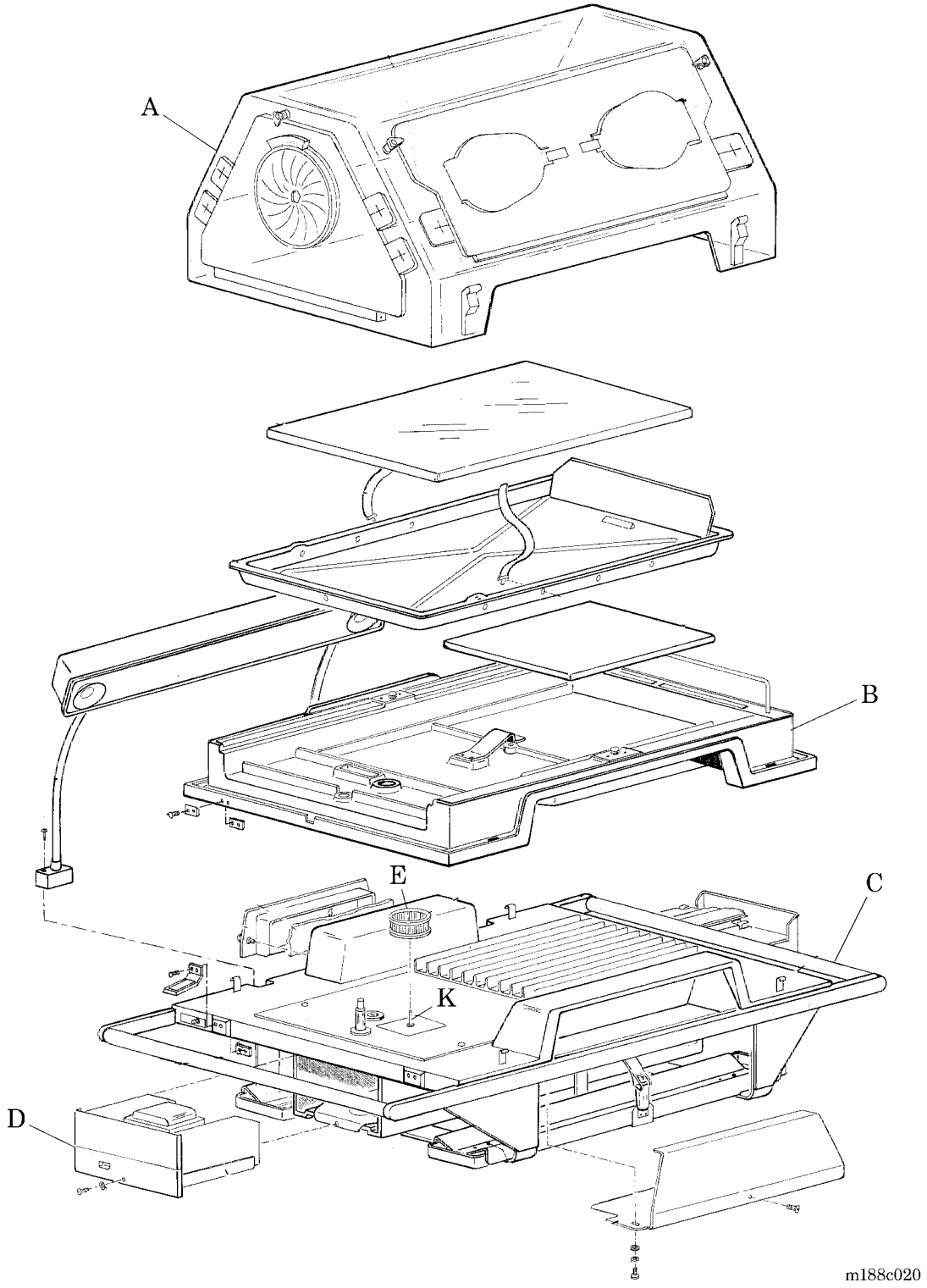
Figure 4-10. Fan Motor



5. Using a screwdriver, remove the four #6-32 flat head screws (G) that secure the round motor mounting plate (H) to the fan motor (I).

6. Remove the fan motor (I) through the opening in the base assembly (C), and discard.

Figure 4-11. Transport Incubator



Replacement

1. Install the fan motor (I) through the opening in the base assembly (C) (see figure 4-10 on page 4-15).

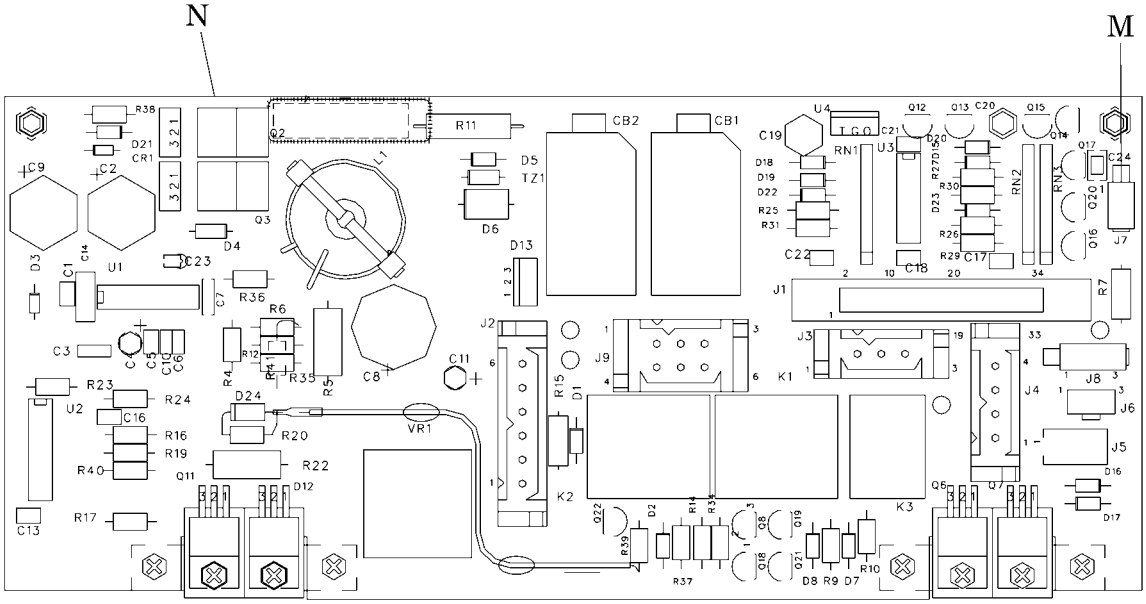
2. Using a screwdriver, install the four #6-32 flat head screws (G) that secure the round motor mounting plate (H) to the fan motor (I).

3. Install the adhesive-backed, motor, dust cover (F) over the opening (L).

4. Install the power chassis (D) into the base assembly (C) (refer to procedure 4.2) (see figure 4-11 on page 4-16).

5. Connect the red lead, pin 2, and the gray lead, pin 1, of the plug P7 from the fan motor (I) (see figure 4-10 on page 4-15) to the corresponding pins on connector J7 (M) on the power P.C. board (N) (see figure 4-12 on page 4-17).

Figure 4-12. Power P.C. Board



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CAUTION:
When installing the impeller, do not place excessive axial force on the motor shaft. Motor bearing damage could occur.

6. Install the impeller (E) onto the motor shaft (K) (see figure 4-11 on page 4-16). Do not place excessive axial force on the motor shaft (K).
7. Power up the incubator (C).
8. Verify that the impeller (E) rotates freely.
9. Turn off the incubator (C).
10. Assemble the hood (A) and upper shell (B) onto the incubator (C).
11. Power up the incubator (C).
12. Allow the temperature to stabilize.
13. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

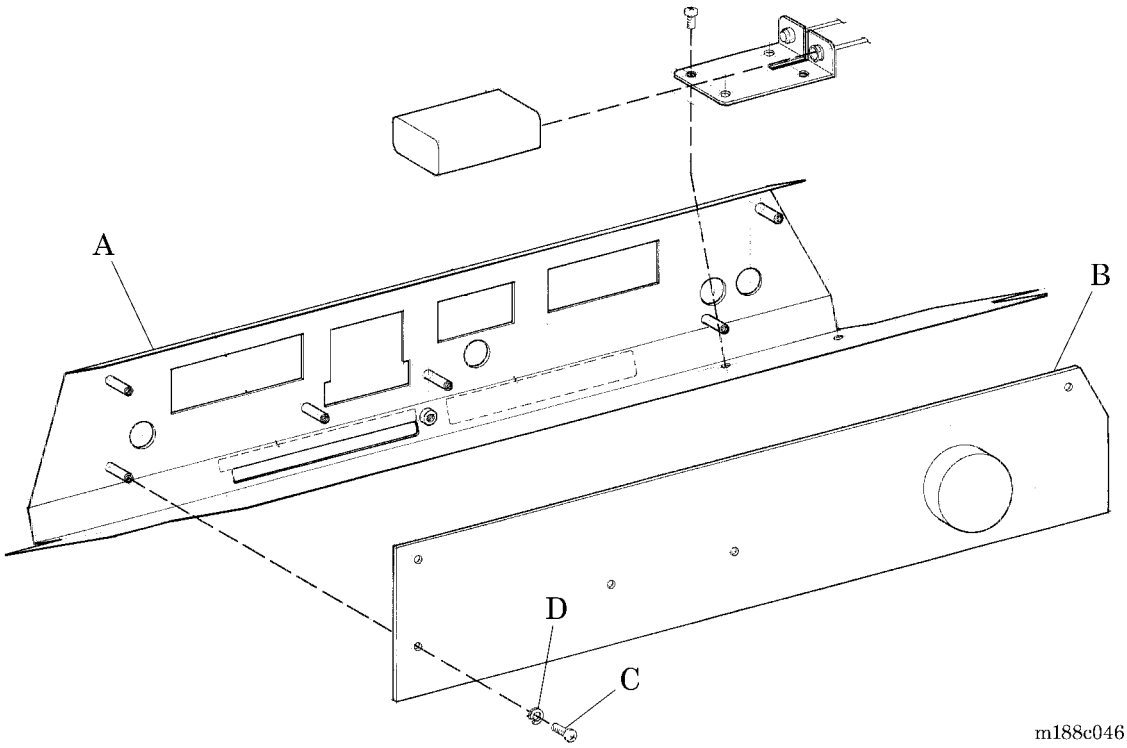
4.8 Controller P.C. Board

Tools required: Phillips head screwdriver

Removal

1. Remove the control panel assembly (A) from the unit (refer to procedure 4.1) (see figure 4-13 on page 4-19).

Figure 4-13. Controller P.C. Board



2. Disconnect all connections from the controller P.C. board (B).

3. Using a phillips head screwdriver, remove the five screws (C) and five lockwashers (D) that secure the controller P.C. board (B) to the control panel assembly (A).

4. Remove the controller P.C. board (B) from the control panel assembly (A) (see “Component Handling” on page 6-12).

Replacement

1. Perform the removal procedure in reverse order.

2. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

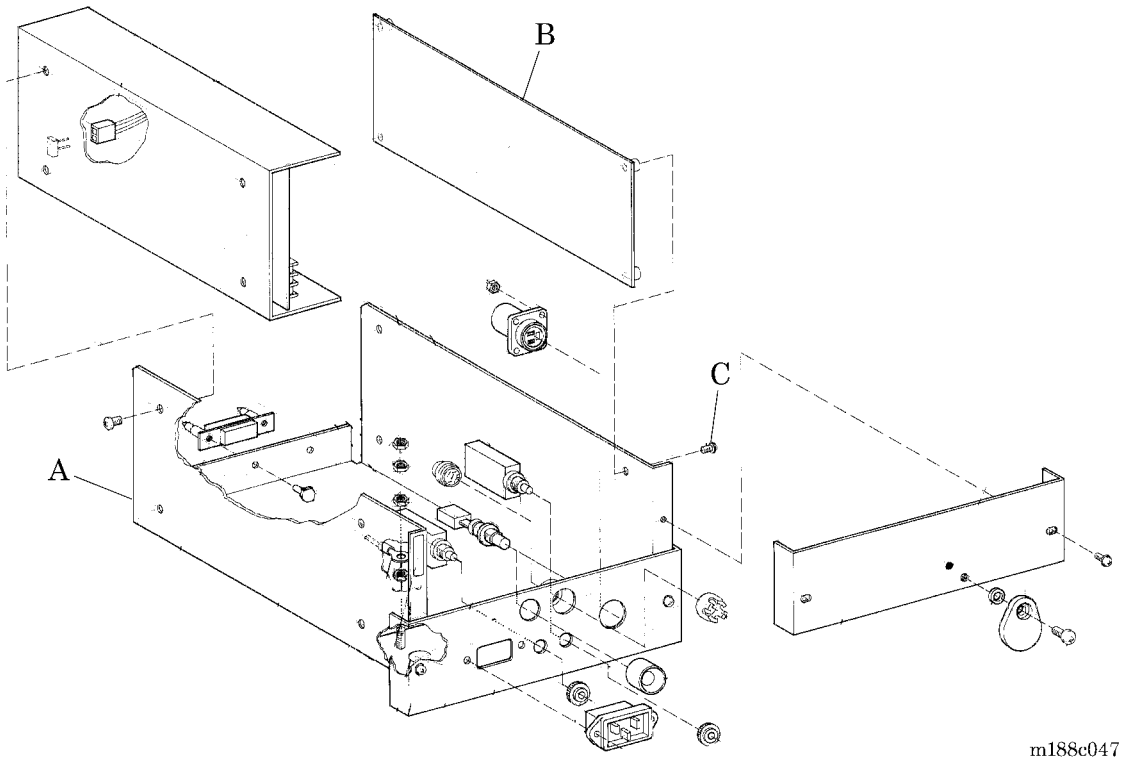
4.9 Power P.C. Board

Tools required: Phillips head screwdriver

Removal

1. Remove the power chassis (A) from the unit (refer to procedure 4.2) (see figure 4-14 on page 4-21).

Figure 4-14. Power P.C. Board



2. Disconnect all connections from the power P.C. board (B).

3. Using a phillips head screwdriver, remove the four screws (C) that secure the power P.C. board (B) to the power chassis (A).

4. Remove the power P.C. board (B) from the power chassis (A) (see "Component Handling" on page 6-12).

Replacement

1. Perform the removal procedure in reverse order.

2. To ensure proper operation of the Transport Incubator, perform the "Function Checks and General Operation Checkout" on page 2-4.

Chapter 5
Parts List

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NOTES:

Warranty

HILL-ROM COMPANY, INC.
LIMITED WARRANTY

Hill-Rom Company, Inc. (Hill-Rom) has a long tradition of providing superior products and service to our customer. Our goal is "Total Customer Satisfaction". In that spirit, Hill-Rom is proud to offer the following warranty.

GENERAL WARRANTY (APPLICABLE UNLESS A SPECIFIC WARRANTY IS LISTED)

Hill-Rom warrants to the original purchaser that its products and replacement parts shall be free from defects in material and workmanship for a period of one (1) year from date of delivery. Hill-Rom's obligation under this warranty is expressly limited to supplying replacement parts and/or service for, or replacing, at its option, any product which is, in the sole discretion of Hill-Rom, found to be defective. In addition to the foregoing one year warranty, Hill-Rom warrants to the original purchaser that the frame and welds on its products will be free from structural defects for the life of the product. Any product upgrade or modification initiated by Hill-Rom does not affect the original product warranty.

SPECIFIC WARRANTIES

MATTRESS WARRANTIES

Hill-Rom warrants to the original purchaser that its mattress product shall be free from defects in material and workmanship for a period of two (2) years from date of delivery. However, electro mechanical mattress components (compressors, valves, printed circuit boards, hoses, and couplers) are covered by the general one (1) year warranty.

EXPENDABLES WARRANTIES

A sixty (60) day limited warranty from date of delivery applies to expendable parts such as cushions, coverlets, software diskettes, locator badge batteries, dome light incandescent bulbs, overhead fluorescent tubes, heating elements, temperature probes, filter sheets, and microspheres. This warranty is limited to replacement of the parts covered.

TO OBTAIN PARTS AND SERVICE

In the United States, call Hill-Rom Technical Support Department at (800) 445-3720, Monday through Friday. In Canada, call Hill-Rom Technical Support Department at (800) 267-2337, Monday through Friday. Outside the United States and Canada, call your authorized Hill-Rom Distributor. In order to expedite service, we request you furnish the following information: customer identification number, product model number, serial number, and description of problem. A qualified specialist will provide, via telephone (United States and Canada), or FAX (Outside the United States and Canada), troubleshooting assistance for facility personnel and provide necessary parts to make repairs. If troubleshooting determines the need for on-site technical service, a qualified service representative will be dispatched. Replacement of non-technical items will be the responsibility of the customer. If requested by Hill-Rom, products or parts for which a warranty claim is made shall be returned prepaid to Hill-Rom's factory.

OUT OF WARRANTY EXCHANGE POLICY

After the expiration of the original warranty, upon request, Hill-Rom will ship as a replacement, components such as selected: motors and printed circuit boards, for like units returned to Hill-Rom by the original purchaser at a substantial savings. Please call Hill-Rom Technical Support Department for current pricing.

PARTS AVAILABILITY POLICY

Hill-Rom will offer parts for new and remanufactured products for ten (10) years from date of sale; for communications products for five (5) years from date of sale.

Note: Some original component parts and assemblies may not be available; functional equivalents may be substituted.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS WARRANTIES AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS OF PURPOSE. HILL-ROM'S OBLIGATION UNDER THESE WARRANTIES SHALL NOT INCLUDE ANY LIABILITY FOR LOSS OF PROFITS, DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES OR DELAYS. Some states, provinces, or countries do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply. Any improper or negligent use, any alterations or repairs not in accordance with Hill-Rom's manuals or performed by others in such manner as in Hill-Rom's sole judgment affects the product materially and adversely, shall void these warranties. These warranties do not cover failures due to misuse, abuse, neglect, or lack of routine maintenance. No employee or representative of Hill-Rom is authorized to change these warranties in any way or grant any other warranty unless in writing and signed by a Hill-Rom officer. These warranties provide specific legal rights; but, there may be other available rights, which vary from state to state, province to province, or country to country.

Revised July 6, 2001

Hill-Rom Company, Inc., 1069 State Route 46 E, Batesville, IN 47006-9167

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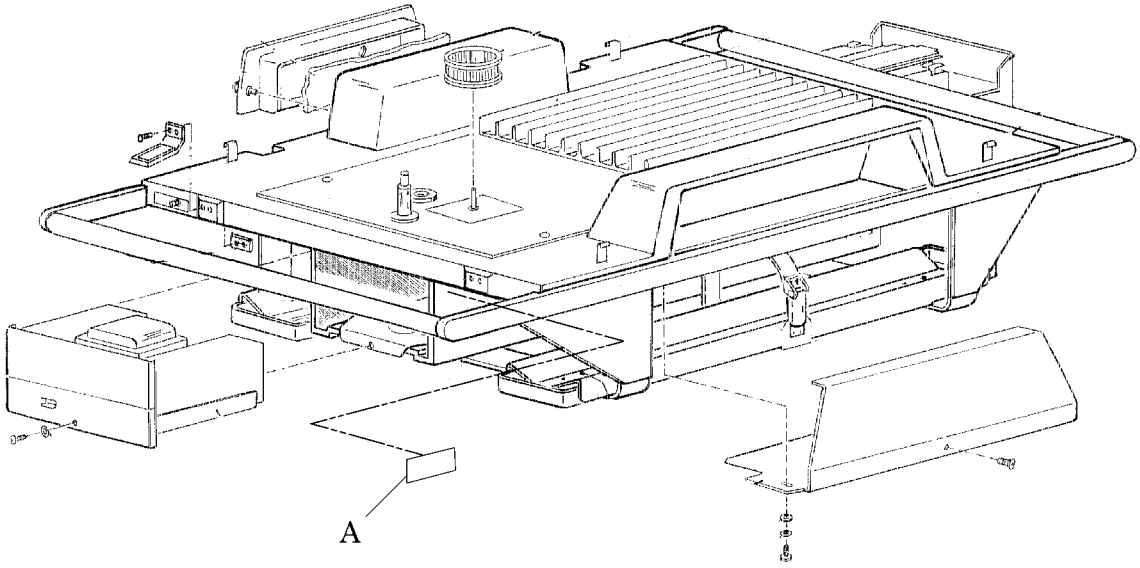
NOTES:

Service Parts Ordering

Using the parts lists in this manual, identify the part number(s) you require. Find the product number and serial number on the product identification label (A) (see figure 5-1 on page 5-5).

Figure 5-1. Product Identification Label Location



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Call Hill-Rom Technical Support at (800) 445-3720 with the following information:

- Six-digit customer account number
- Purchase order number
- Product number
- Serial number
- Part number(s)

To promptly order parts, request part prices and availability, or follow up on a service order, use the following Hill-Rom fax number:

(812) 934-8472

Terms:

- Net 30 days
- F.O.B. Batesville, IN
- Prepaid shipping charges added to invoice
- All orders shipped UPS ground unless specified

Address all inquiries to:

ATTN TECHNICAL SUPPORT—PARTS
HILL-ROM COMPANY, INC.
1069 STATE ROUTE 46 E
BATESVILLE IN 47006-9167

Address all return goods to:

HILL-ROM AIR-SHIELDS, INC.
330 JACKSONVILLE ROAD
HATBORO PA 19040-2211

NOTE:
To eliminate possible delays or incorrect billings, **do not** return any items without a Return Material Authorization (RMA) number. When a return is requested, an RMA packet is included with each order. This packet includes an RMA number, instructions, and a shipping label. If an RMA number is not available, obtain one by phoning Hill-Rom Technical Support at (800) 445-3720.

Exchange Policy

The following are policies for in-warranty and out-of-warranty exchanges from Hill-Rom.

In-Warranty Exchanges

In some cases, Hill-Rom will request that parts/products be returned for inspection. When this occurs, you are expected to return parts/products within 30 days of receipt of the exchange part. If you fail to return the inoperative parts/products within the 30 day period, Hill-Rom will invoice your facility for the full selling price of the parts/products.

NOTE:
The preceding billing procedure pertains **only** to parts/products that Hill-Rom requests to be returned.

In some cases, the invoice accompanying the parts will show the full selling price (only for internal use at Hill-Rom). Do not confuse this price with your price.

Do not return any parts without an RMA number. When parts/products have been requested to be returned, Hill-Rom will include an RMA packet with the parts/products shipment. If an RMA number is not available, obtain one by phoning Hill-Rom Technical Support at (800) 445-3720.

Out-of-Warranty Exchanges

You are expected to return the inoperative parts/products within 30 days of receipt of the exchange part. Hill-Rom will include an RMA packet with the parts/products shipment. If an RMA number is not available, obtain one by phoning Hill-Rom Technical Support at (800) 445-3720. Hill-Rom will invoice your facility for the full selling price of the parts/products. Upon return of the inoperative parts/products, Hill-Rom will issue a credit to your facility for **the difference between the exchange price and the full selling price of the parts/products**.

Recommended Spare Parts

For a recommended spare parts list to service five or more units, see table 5-1 on page 5-8.

Table 5-1. Recommended Spare Parts

Part Number	Quantity	Description
17 BH 175	1	Circuit breaker, special, thermistor, 15 A 240V/28V
17 BH 236	1	Circuit breaker, special thermistor, 6.0 A 250V/28V
17 627 94	2	Transistor, N-channel power, field-effect
17 628 13	2	Transistor, P-channel, power, field-effect
17 629 58	2	Integrated circuit, quad comparator
17 634 07	1	Integrated circuit, regulator, step-down, switch change
67 000 38	2	Grommet, special, hood access
67 070 75	1	Filter, replacement, carton of six sets
67 500 09	2	Draw latch, soft
67 908 00	1	Fan motor replacement kit
67 502 58	1	Thermistor assembly
17 806 92	2	Lamp, incandescent, G-6, DC bayonet, 6.5V
67 507 60	1	Power supply, +15V DC
67 908 06	1	Replacement kit, P.C. board 1, control
68 120 03	2	Gasket, access door
68 120 56	2	Cuff, access door
68 510 16-R	2	Tubing, 0.12" inner diameter 0.44" long
68 510 20	2	Shaft, roller
68 902 97	2	Replacement latch assembly, oval doors
68 510 46-R	2	Tubing, Teflon®[a], 0.09" inner diameter 0.008" wide 0.44" long
68 902 85	1	Access door assembly
78 293 10	2	Bumper, clear polyurethane, self-adhesive

a. Teflon® is a registered trademark of E. I. du Pont and de Nemours and Company.

Part Number	Quantity	Description
67 361 26	1	Battery, 12V, rechargeable, marked
67 500 65-R	1	Replacement power cord assembly/link, domestic, 10' (100V/120V models only)
67 500 66-R	1	Power cord assembly/link, Verband Deutscher Elektrotechniker (VDE), 10' with Velcro®[a] (220V/240V models only)
67 502 76	1	Cable assembly, DC power cord
67 501 00-R	1	Hood, inner, low six grommets
67 908 70	1	Replacement hood, Plexiglas®[b], English (standard)
68 209 70	1	Probe, temperature, skin
26 920 70	1	Iris port sleeve, carton of 100
68 120 70	1	Access port cuffs, oval, replacement, carton of 100
67 070 75	1	Filter, replacement, carton of six sets
67 903 95	1	Restraint strap, replacement, carton of 100
67 903 75	1	Humidity pad, carton of 25 sets
68 209 20	1	Probe 1, skin temperature, disposable, box of ten
68 209 46	1	Critter Covers® Probe Cover, box of 100
68 209 45	1	Critter Covers® Probe Cover, carton of 600
68 120 54	1	Neat-Clips, carton of 50, 1.00" diameter
68 120 53	1	Neat-Clips, carton of 100, 0.38" diameter
26 920 72	1	Disposable storage covers, carton of 50
67 903 85	1	Mattress, replacement, carton of 10

a. Velcro® is a registered trademark of Velcro Industries, BV (a Dutch corporation).
b. Plexiglas® is a registered trademark of Rohm and Haas Company.

Transport Incubator

Figure 5-2. Transport Incubator

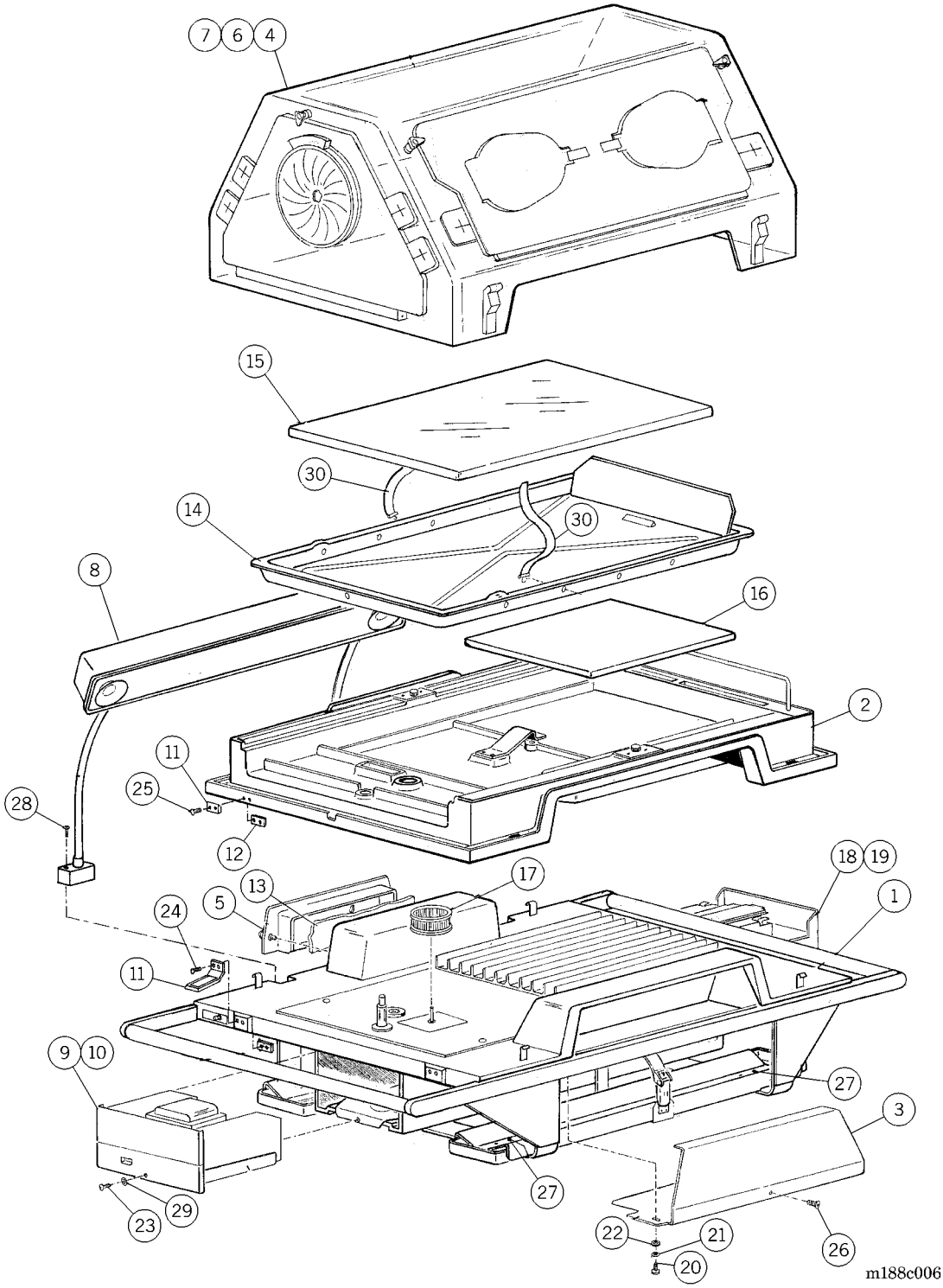

Table 5-2. Transport Incubator

Item Number	Part Number	Quantity	Description
1	67 502 70	1	Base assembly with handrail
2	67 500 20-R	1	Assembly, upper structure
3	67 503 70-R	1	Control panel assembly
4	67 501 00-R	1	Hood, inner, low, six grommet
5	67 501 08	1	Cover, filter
6	67 506 70-R	1	Replacement hood assembly, outer, six grommet (Model TI500 only)
7	67 908 60	1	Replacement hood assembly, outer, English (Model TI500-1, 1E, or 1C only)
8	67 505 70	1	Lamp assembly, incandescent
9	67 507 70-R	1	Power chassis assembly, 100V-120V
10	67 507 80-R	1	Power chassis assembly, 220V-240V
11	67 000 51	4	Latch, draw
12	67 000 52	4	Plate, tapped
13	67 070 75	1	Filter, replacement, carton of six sets
14	67 501 05-R	1	Mattress tray assembly with deflector
15	67 020 71	1	Mattress assembly (reusable)
16	67 903 75	1	Humidity pad, carton of 25 sets
17	67 100 48	1	Impeller, 0.12" inner diameter, 2.12" outer diameter, 1.00" wide
18	67 504 70-R	1	Battery tray assembly, single
19	67 503 04	1	Second battery option (optional)
20	99 031 38	2	Screw, #8-32 x 3/8" truss phillips stainless steel
21	99 122 95	2	Washer, lock, spiral, #8 S4
22	99 122 62	2	Washer, flat, #8 stainless steel
23	99 040 86	1	Screw, #10-32 x 5/16" truss phillips stainless steel
24	99 012 27	2	Screw, #4-40 x 7/8", flat slotted stainless steel
25	99 011 36	2	Screw, #4-40 x 7/16", flat phillips stainless steel

Item Number	Part Number	Quantity	Description
26	99 042 62	1	Screw, #10-32 x 5/8" flat phillips stainless steel
27	99 040 52	4	Screw, #10-32 x ¼" truss phillips stainless steel Nylok®[a]
28	99 033 45	2	Screw, #8-32 x 1.00"
29	99 124 16	1	Washer, lock, spiral, #10
30	67 903 95	2	Restraint strap, replacement, carton of ten
31	67 500 65-R	1	Replacement power cord assembly/link, domestic, 10' (not shown)
32	67 500 67	1	Power cord assembly/link, Verband Deutscher Elektrotechniker (VDE), European, 10' (not shown)
33	67 502 76	1	Cable assembly, DC power cord (not shown)

a. Nylok® is a registered trademark of Nylok Fastener Corporation.

NOTES:

Base Assembly with Handrail—P/N 67 502 70

Figure 5-3. Base Assembly with Handrail—P/N 67 502 70

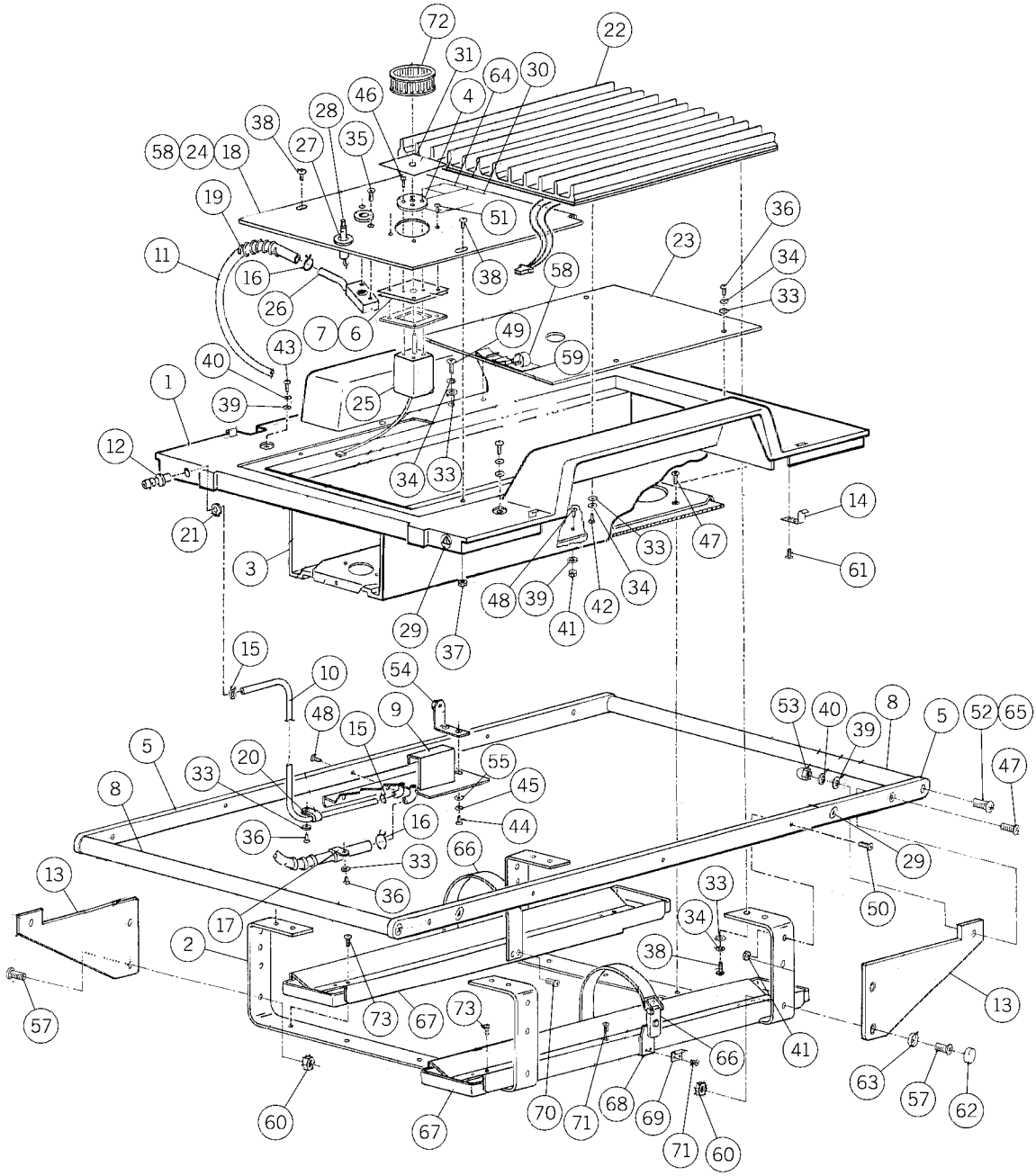

Table 5-3. Base Assembly with Handrail—P/N 67 502 70

Item Number	Part Number	Quantity	Description
1	67 502 02	1	Base molding
2	67 502 07	1	Support, base
3	67 502 01	1	Plate, support, power supply and battery
4	67 101 11	1	Plate, clamp, motor, round
5	67 502 03	2	Guard rail, front/rear
6	67 101 09	1	Plate, clamp, brushless motor
7	67 101 12	1	Mounting pad, motor
8	67 502 04	2	Handle, guardrail
9	67 502 06	1	Plenum, filter
10	67 010 07-R	1	Tubing, clear polyvinyl chloride (PVC), ¼" inner diameter x 14.00" long
11	67 010 08-R	1	Tubing, clear PVC, ½" inner diameter x 10½" long
12	67 000 25	1	Fitting, hose connector
13	67 502 08	2	Gusset, guardrail
14	67 502 05	1	Catch, latch
15	20 015 12	2	Clamp, hose (for 7/16" outer diameter)
16	20 015 14	2	Clamp, hose (for ¾" outer diameter)
17	17 061 76	1	Clamp, cable, loop tie, nylon, 0.69" inner diameter
18	77 000 65	1	Clip, plastic, self-adhesive (¼" diameter)
19	67 010 46	2	Spring, compression, 0.85" outer diameter 0.67" wide 4.00" long
20	17 720 37	1	Clamp, cable, loop tie, nylon, 0.38" inner diameter
21	99 182 05	1	Ring, retaining, external, stainless steel
22	67 502 55-R	1	Heater assembly
23	67 300 07	1	Plate, cover
24	67 107 70	1	Cover plate assembly, air inlet
25	67 908 00	1	Fan motor replacement kit
26	67 010 83-R	1	Replacement inlet assembly, air/oxygen mix
27	67 000 50	1	Gasket, air intake

Item Number	Part Number	Quantity	Description
28	67 502 58	1	Thermistor assembly
29	68 160 05	2	Label, manual reference symbol
30	67 100 19	1	Label, impeller position
31	67 100 44	1	Cover, adhesive back
32	67 501 49	1	Cable assembly, ribbon, power board to controller (not shown)
33	99 122 62	10	Washer, flat, #8 stainless steel
34	99 122 95	6	Washer, lock, spiral, #8 S4
35	99 022 99	1	Screw, #6-32 x 5/16", flat phillips stainless steel
36	99 031 38	3	Screw, #8-32 x 3/8" truss phillips stainless steel
37	99 106 32	2	Nut, hex, #8-32 keps zinc
38	99 032 85	6	Screw, #8-32 x ¾", truss phillips stainless steel
39	99 123 62	4	Washer, flat, #10 stainless steel (0.62" thick)
40	99 124 16	3	Washer, lock, spiral, #10
41	99 107 36	4	Nut, hex, #10-32 keps zinc
42	99 032 57	1	Screw, #8-32 x 5/8", truss phillips stainless steel Nylok®[a]
43	99 042 01	2	Screw, #10-32 x ½" truss phillips stainless steel
44	99 023 31	1	Screw, #6-32 x 3/8" truss phillips stainless steel
45	99 122 16	1	Washer, lock, spiral, #6 S4
46	99 023 39	4	Screw, #6-32 x 3/8", flat phillips stainless steel
47	99 042 90	6	Screw, #10-32 x ¾" flat phillips stainless steel
48	99 042 62	2	Screw, #10-32 x 5/8" flat phillips stainless steel

a. Nylok® is a registered trademark of Nylok Fastener Corporation.

Item Number	Part Number	Quantity	Description
49	99 031 99	1	Screw, #8-32 x ½", truss phillips stainless steel Nylok®[a]
50	99 043 19	4	Screw, #10-32 x 7/8" flat phillips stainless steel
51	99 010 62	4	Screw, #4-40 x ¼", flat phillips stainless steel
52	99 064 51	4	Screw, 5/16"-18 x ¾" flat phillips stainless steel
53	99 107 20	4	Nut, acorn, #10-32 aluminum
54	67 070 04	1	Bracket, plenum
55	99 122 03	1	Washer, flat, #6 stainless steel
56	67 502 76	1	Cable assembly, DC power cord (not shown)
57	99 056 65	4	Screw, ¼"-20 x 5/8" pan phillips stainless steel
58	17 725 44	2	Clip, cord retaining
59	17 063 08	1	Clamp, ribbon cable, PVC, self-adhesive, 2.31"
60	99 109 41	4	Nut, hex, ¼"-20 keps zinc
61	99 031 50	1	Screw, #8-32 x 3/8" pan phillips stainless steel, sems external
62	67 502 50	4	Cover, screw, light grey, ¼"-20 pan
63	67 502 51	4	Base, screw, ¼"-20 pan
64	68 126 30	1	Label, warning, hot heater, English
65	99 901 38	As required	Loctite®[b] screwlock #222
66	67 500 31	2	Clamp assembly, tank, 8.56" long
67	67 500 30	2	Support, tank
68	67 500 32	2	Strap, clamp assembly/tank support
69	24 144 01	2	Hook, latch, modified
70	99 023 50	8	Screw, #6-32 x 3/8" pan phillips zinc, sems internal

a. Nylok® is a registered trademark of Nylok Fastener Corporation.
b. Loctite® is a registered trademark of Loctite Corporation.

Item Number	Part Number	Quantity	Description
71	99 022 83	6	Screw, #6-32 x ¼" pan phillips stainless steel, sems external
72	67 100 48	1	Impeller, 0.12" inner diameter, 2.12" outer diameter, 1.00" wide
73	99 040 52	2	Screw, #10-32 x ¼" truss phillips stainless steel Nylok®[a]

a. Nylok® is a registered trademark of Nylok Fastener Corporation.

NOTES:

Replacement Outer Hood Assembly—P/N 67 506 70-R and 67 908 60

Figure 5-4. Replacement Outer Hood Assembly—P/N 67 506 70-R and 67 908 60

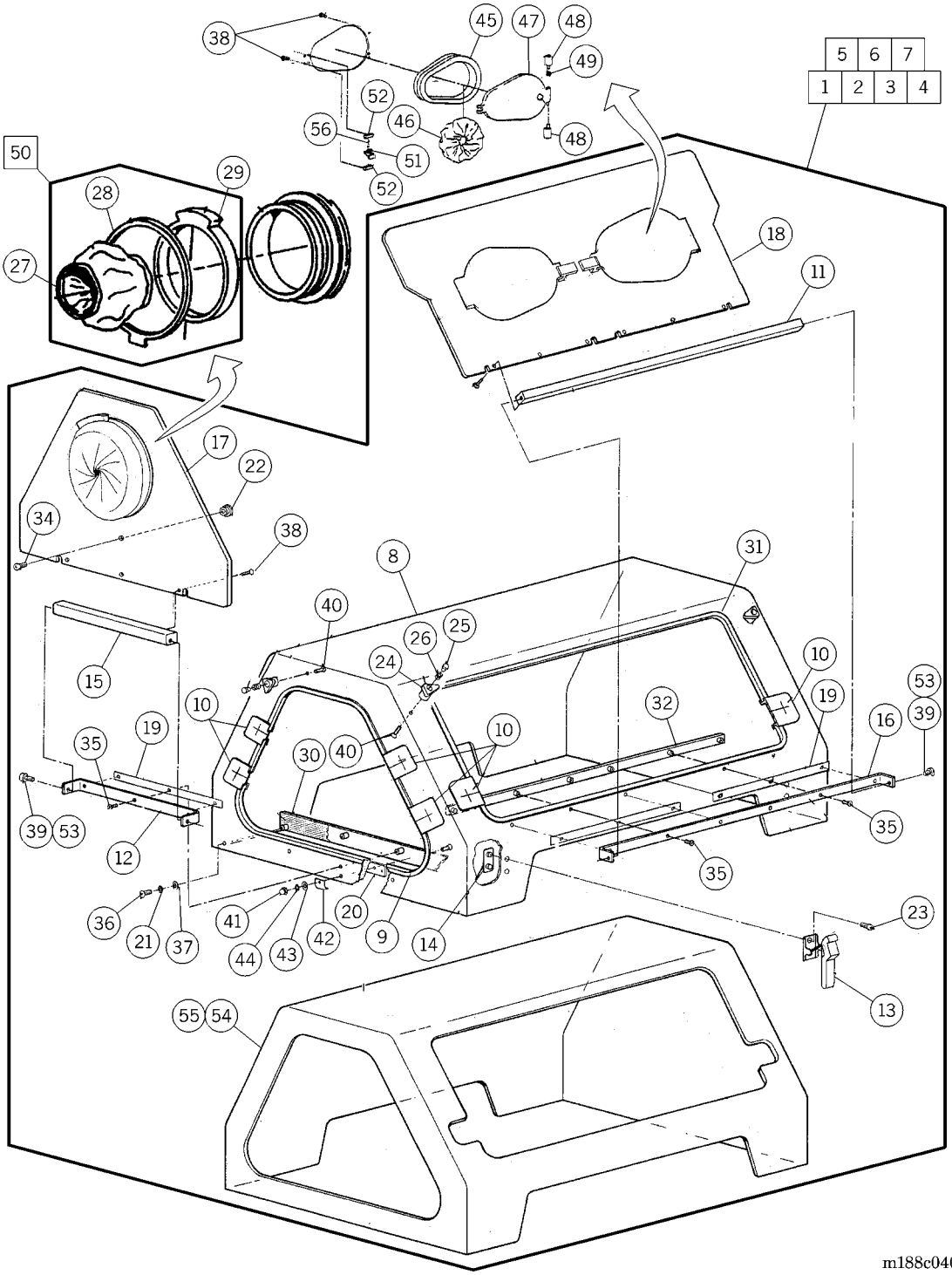

Table 5-4. Replacement Outer Hood Assembly—P/N 67 506 70-R and 67 908 60

Item Number	Part Number	Quantity	Description
1	67 908 70	1	Replacement hood, Plexiglas®[a], English (standard) (Model TI500 only)
2	67 908 80	1	Replacement hood, outer, high, English (Model TI500-1E or 1C only)
3	67 908 81	1	Replacement hood, outer, high, Spanish (Model TI500-1E or 1C only)
4	67 908 82	1	Replacement hood, outer, high, French (Model TI500-1E or 1C only)
5	67 908 83	1	Replacement hood, outer, high, German (Model TI500-1E or 1C only)
6	67 908 84	1	Replacement hood, outer, high, Italian (Model TI500-1E or 1C only)
7	67 908 85	1	Replacement hood, outer, high, Swedish (Model TI500-1E or 1C only)
8	67 516 10-R	1	Hood, outer, high, six grommet (Model TI500-1H, HE, or 1HC only) (Plexiglas® model only)
9	67 506 20	1	Gasket, end door, 33.00" long
10	67 000 38	6	Grommet, special, hood access
11	67 506 08	1	Pivot, hinge, 19¾" long, painted
12	67 506 05	1	Bracket, hinge, 8.81" long
13	67 500 09	2	Draw latch, soft
14	67 500 07	2	Plate, latch
15	67 506 07	1	Pivot, hinge, 8¾" long, painted
16	67 506 06	1	Bracket, hinge, 19.82" long
17	67 506 01-R	1	Door, end, one iris port
18	67 506 00-R	1	Replacement door, front, two access doors
19	67 030 23	3	Pad, hinge
20	67 030 24	1	Pad, head end
21	99 121 36	2	Washer, lock, spiral, #4 S4

a. Plexiglas® is a registered trademark of Rohm and Haas Company.

Item Number	Part Number	Quantity	Description
22	68 232 25	1	Knob, retainer, ¾" outer diameter x 0.66" long
23	99 030 76	2	Screw, #8-32 x ¼" truss phillips stainless steel Nylok®[a]
24	67 000 66	3	Latch, door
25	67 000 67	3	Stud, latch guide
26	67 000 68	3	Spring, compression, 0.37" outer diameter, 0.04" wide, 0.44" long
27	26 920 70	1	Iris port sleeve, carton of 100
28	68 120 32	1	Ring, retaining, iris port, clear
29	68 120 76	1	Ring assembly, iris port, large flange
30	67 030 21	1	Strip, tapped, end
31	67 506 21	1	Gasket, front door, 56.00" long
32	67 000 47	1	Strip, tapped, front
33	Reference only	As required	Adhesive, gel, Loctite®[b] #454 (not shown)
34	99 023 92	3	Screw, #6-32 x ½", truss phillips stainless steel
35	99 010 77	9	Screw, #4-40 x 5/16", flat phillips stainless steel
36	99 010 76	4	Screw, #4-40 x 5/16", flat phillips stainless steel
37	99 121 23	4	Washer, flat, 0.115" inner diameter ¼" outer diameter 0.06" thick nylon
38	99 023 64	7	Screw, #6-32 x 7/16" truss phillips stainless steel Nylok®
39	99 195 04	4	Screw, shoulder, #8-32 slotted head stainless steel
40	99 031 99	3	Screw, #8-32 x ½", truss phillips stainless steel Nylok®
41	99 106 20	1	Nut, acorn, #8-32 aluminum
42	67 030 09	1	Spring, door opener

a. Nylok® is a registered trademark of Nylok Fastener Corporation.
b. Loctite® is a registered trademark of Loctite Corporation.

Item Number	Part Number	Quantity	Description
43	99 122 62	1	Washer, flat, #8 stainless steel
44	99 122 95	1	Washer, lock, spiral, #8 S4
45	68 120 03	2	Gasket, access door
46	68 120 70	2	Access port cuffs, oval, replacement, carton of 100
47	67 908 01	2	Replacement kit, access door assembly
48	68 510 05	4	Pivot, hinge, access door
49	67 500 15	2	Spring, torsion
50	68 120 74	1	Iris port assembly, large flange
51	68 902 97	2	Replacement latch assembly, oval doors
52	68 510 40	4	Pivot, latch, access door
53	99 901 34	As required	Adhesive, Loctite®[a] #404
54	67 501 00-R	1	Hood, inner, low, six grommet
55	67 516 00-R	1	Replacement inner hood, high, six grommet (Model TI500-1H, HE, or 1HC only)
56	99 160 54	2	O-ring, 3/8" x ½" x 1/16"
57	67 502 10	1	Label, oxygen concentration guide (not shown)
58	67 502 20	1	Label, danger—explosion/fire hazard, English (not shown)
59	67 502 30	1	Label, oxygen administration, English (not shown)
60	67 501 40	1	Label, operating instructions, English (not shown)
61	67 503 40	1	Label, warning, hood cleaning, English (not shown)

a. Loctite® is a registered trademark of Loctite Corporation.

Control Panel Assembly—P/N 67 503 70-R

Figure 5-5. Control Panel Assembly—P/N 67 503 70-R

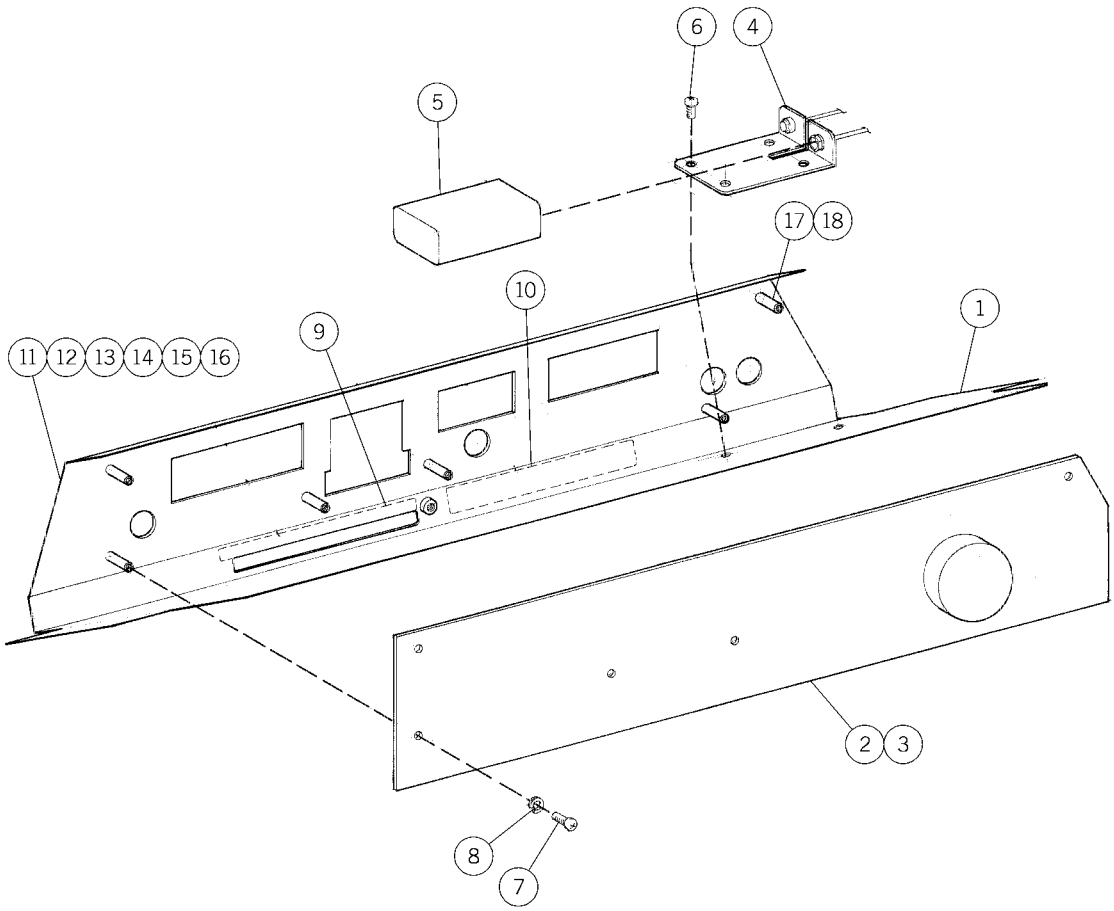

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Table 5-5. Control Panel Assembly—P/N 67 503 70-R

Item Number	Part Number	Quantity	Description
1	67 502 00	1	Support, control panel
2	67 908 06	1	Replacement kit, P.C. board 1, control
3	67 509 71	1	P.C. board 1 assembly, controller board
4	67 503 35	1	Battery holder assembly, controller
5	17 807 65	1	Battery, nickel-mh, rechargeable, 7.2V
6	99 010 18	4	Screw, #4-40 x 1/8", truss phillips stainless steel
7	99 023 26	5	Screw, #6-32 x 3/8", round phillips stainless steel
8	99 122 16	5	Washer, lock, spiral, #6 S4
9	67 503 50	1	Label, potentiometer identification, English
10	67 503 60	1	Label, potentiometer legend, English
11	67 502 40	1	Overlay, front panel, English
12	67 502 41	1	Overlay, front panel, Spanish
13	67 502 42	1	Overlay, front panel, French
14	67 502 43	1	Overlay, front panel, German
15	67 502 44	1	Overlay, front panel, Italian
16	67 502 45	1	Overlay, front panel, Swedish
17	67 503 49	6	Spacer, 0.219" inner diameter, 0.31" outer diameter, ½" long
18	67 908 02	1	Retrofit kit, P.C. board 1 spacing (units without spacers only)

Power Chassis Assembly—P/N 67 407 70-R and 67 407 80-R

Figure 5-6. Power Chassis Assembly—P/N 67 407 70-R and 67 407 80-R

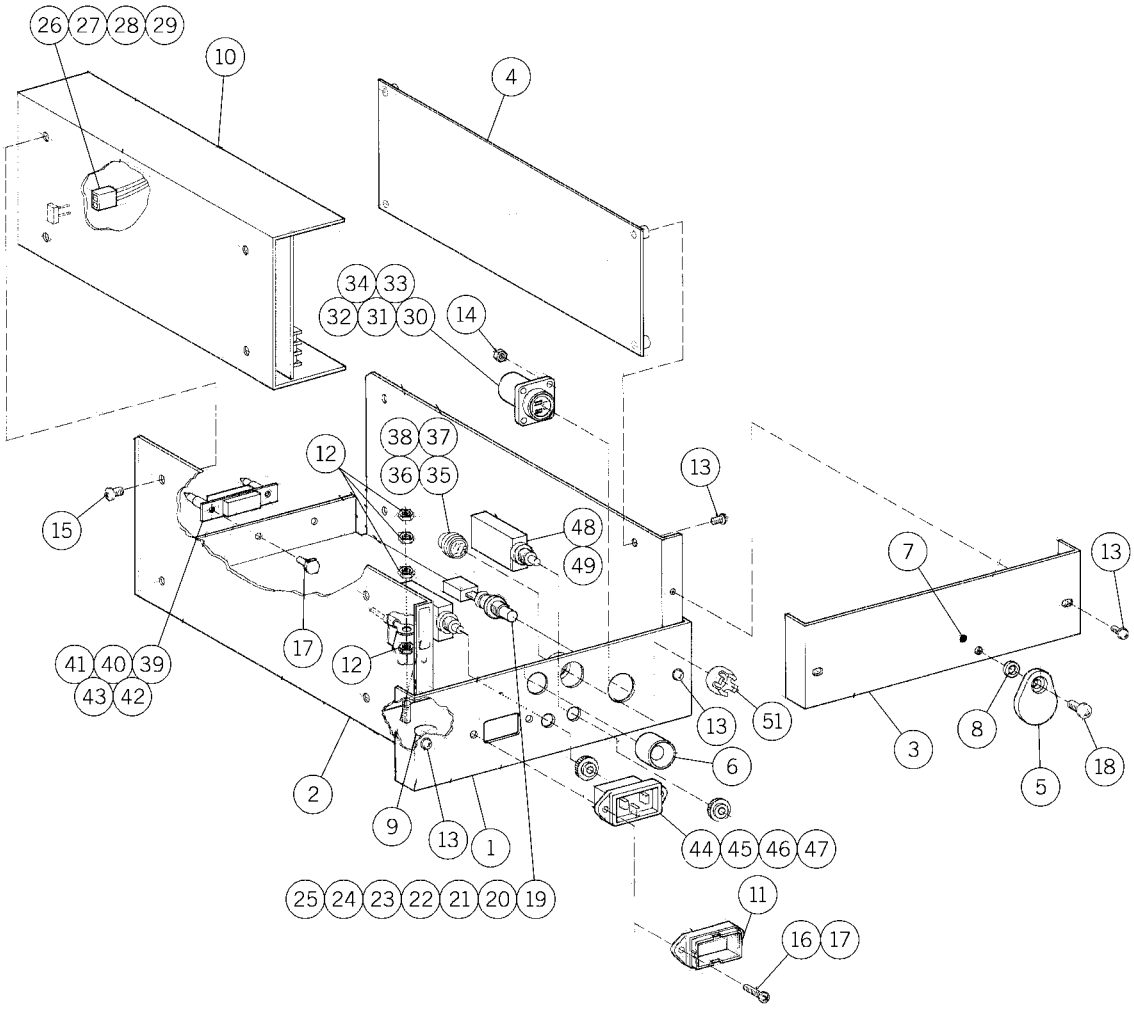

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Table 5-6. Power Chassis Assembly—P/N 67 407 70-R and 67 407 80-R

Item Number	Part Number	Quantity	Description
1	67 507 00	1	Plate, lower, front, power chassis
2	67 507 01	1	Chassis, power supply
3	67 507 02	1	Plate, upper, front, power chassis
4	67 508 70	1	P.C. board 2 assembly, power board
5	26 651 22	1	Plate, cover
6	68 215 26	1	Guard, switch, push-button
7	78 275 10	1	Plug, panel fastening, 0.16" diameter (arrow clip)
8	99 124 40	1	Spacer, 0.194" inner diameter, 0.31" outer diameter, 0.19" long stainless steel
9	68 212 00	1	Label, ground symbol, protective
10	67 507 60	1	Power supply, +15V DC
11	17 735 15	1	Cord lock adapter, inside chassis
12	99 105 70	4	Nut, hex, #6-32 washer keps
13	99 022 83	8	Screw, #6-32 x ¼" pan phillips stainless steel, sems external
14	99 103 33	4	Nut, hex, #4-40 keps zinc
15	99 030 76	4	Screw, #8-32 x ¼" truss phillips stainless steel Nylok®[a]
16	99 011 35	2	Screw, #4-40 x 7/16", truss phillips stainless steel
17	99 901 38	As required	Loctite®[b] screwlock #222
18	99 042 08	1	Screw, #10-32 x ½" pan phillips stainless steel Nylok®
19	67 507 30	1	Cable assembly, power switch (S1)
20	17 682 46	1	Switch, illuminated, white, 6 A
21	17 BP 409	1	Connector housing, plug, single-row, six-position
22	17 735 02	1	Contact, connector, female, 14 AWG to 16 AWG
23	17 738 80	1	Contact

a. Nylok® is a registered trademark of Nylok Fastener Corporation.
b. Loctite® is a registered trademark of Loctite Corporation.

Item Number	Part Number	Quantity	Description
24	17 722 41	1	Terminal, ring, insulated, #6, 22 AWG to 16 AWG
25	17 735 16	1	Terminal, ring, insulated, #6, 16 AWG to 14 AWG
26	67 507 32	1	Cable assembly, voltage sensor
27	17 BP 183	1	Connector housing, plug, four-position
28	17 731 92	1	Contact, connector, 30 AWG to 22 AWG
29	17 724 92	1	Terminal, ring
30	67 507 34	1	Cable assembly, external DC
31	17 730 02	1	Connector housing, receptacle, circle, three-contact
32	17 730 06	1	Contact, connector, female, 16 AWG to 12 AWG
33	17 BP 407	1	Connector housing, plug, single row, three-position
34	17 735 02	1	Contact, connector, female, 14 AWG to 16 AWG
35	67 507 36	1	Cable assembly, skin probe
36	17 AP 366	1	Connector, receptacle, female, round, panel mount, three-position
37	17 BS 392	1	Connector housing, plug, single, locking, two-position
38	17 BS 417	1	Contact, connector, female, 26 AWG to 22 AWG
39	67 507 38	1	Cable assembly, battery, blind mating
40	17 735 01	1	Connector housing, plug, bulkhead mount, four-position
41	17 735 03	1	Contact, connector, male, 14 AWG to 16 AWG
42	17 BP 447	1	Connector housing, plug, double-row, six-position
43	17 735 02	1	Contact, connector, female, 14 AWG to 16 AWG
44	67 507 40	1	Connector assembly, AC power

Item Number	Part Number	Quantity	Description
45	17 732 28	1	Connector, receptacle, male, recessed, AC power
46	17 AP 472	1	Terminal, slip-on, female, insulated, ¼" 22 AWG to 18 AWG
47	17 722 41	1	Terminal, ring, insulated, #6, 22 AWG to 16 AWG
48	17 BH 236	2	Circuit breaker, special thermistor, 6.0A 250V/28V (100V/120V model only)
49	17 BH 233	2	Circuit breaker, special thermistor, 4.0A 250V/28V (220V/240V model only)
50	67 507 44	1	Wire assembly, ground (not shown)
51	67 507 04	1	Retainer, probe
52	67 500 40	1	Label, power supply data, English (not shown)

Battery Tray Assembly—P/N 67 504 70

Figure 5-7. Battery Tray Assembly—P/N 67 504 70

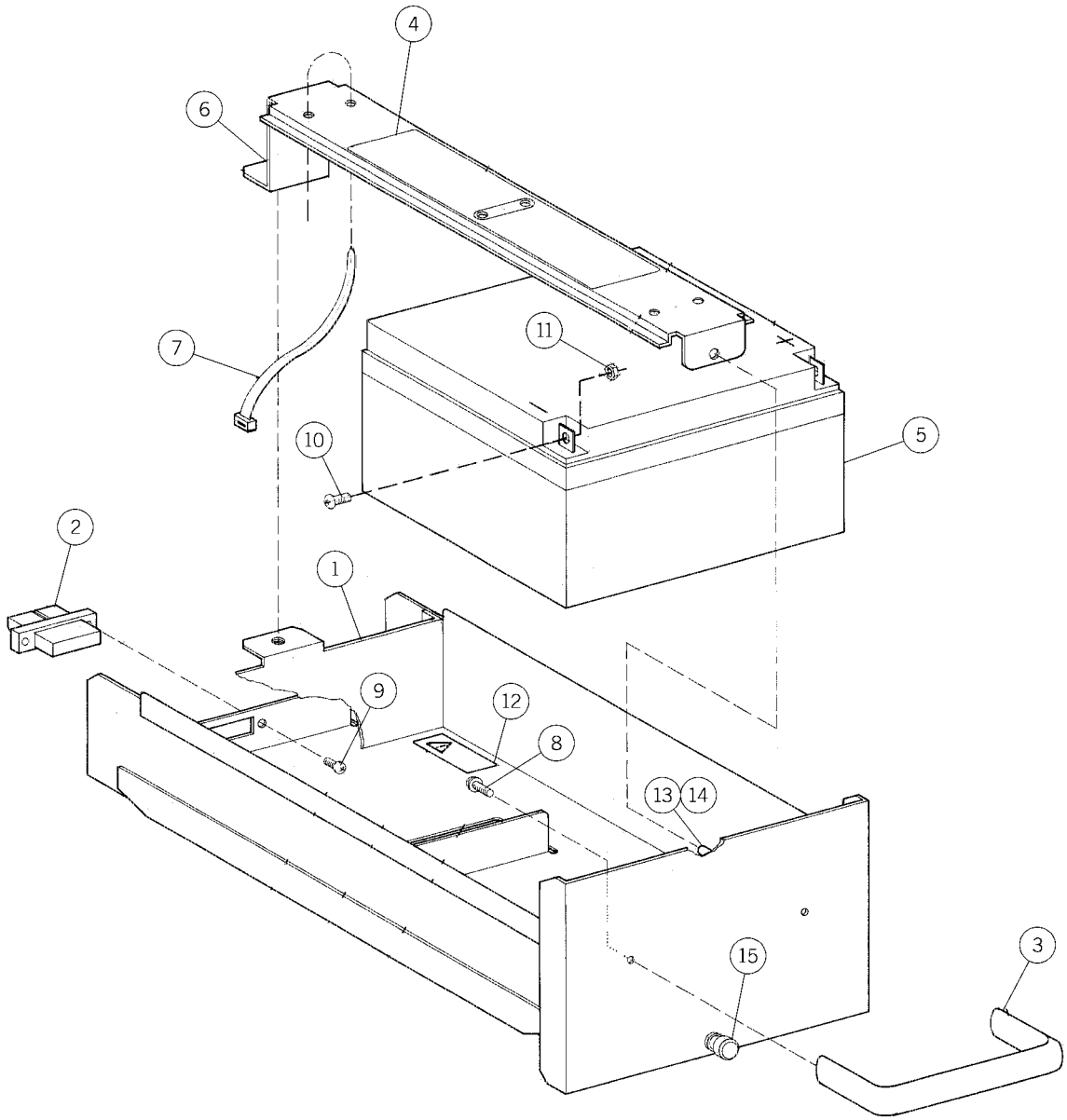

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Table 5-7. Battery Tray Assembly—P/N 67 504 70

Item Number	Part Number	Quantity	Description
1	67 504 00	1	Battery tray weldment
2	67 504 30	1	Cable assembly, battery tray
3	68 422 10	1	Handle, “D”, 4.56" long 1½" high 0.62" wide
4	67 503 10	1	Label, battery replacement, all languages
5	67 361 26	1	Battery, 12V, rechargeable, marked
6	67 504 01	1	Clamp, battery
7	12 995 00	1	Cable tie (4½" long)
8	99 047 51	2	Screw, #10-24 x 3/8" truss phillips stainless steel
9	99 080 13	2	Screw, #2 x 3/16", Plastite®[a], pan phillips zinc
10	99 041 27	2	Screw, #10-32 x 3/8" truss phillips stainless steel
11	99 107 36	2	Nut, hex, #10-32 keps zinc
12	67 500 16	1	Label, single battery use
13	99 116 94	1	Standoff, #6-32 inner diameter ¼" hex 0.78" long aluminum
14	99 022 83	1	Screw, #6-32 x ¼" pan phillips stainless steel, sems external
15	67 304 01	1	Captive screw

a. Plastite® is a registered trademark of Research Engineering & Manufacturing, Inc.

Battery Tray Cable Assembly—P/N 67 504 30

Figure 5-8. Battery Tray Cable Assembly—P/N 67 504 30

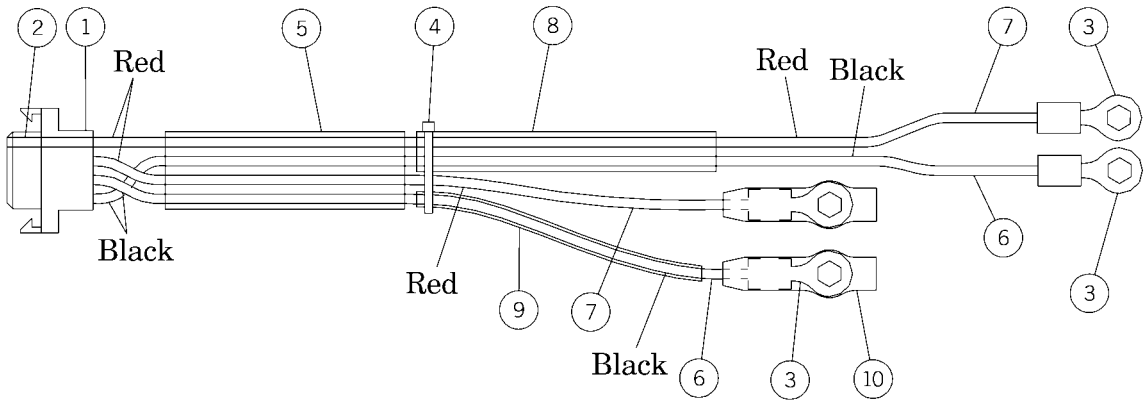

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Table 5-8. Battery Tray Cable Assembly—P/N 67 504 30

Item Number	Part Number	Quantity	Description
1	17 BP 623	1	Connector, housing, receptacle, female, four-position (P4)
2	17 735 02	4	Contact, connector, female
3	17 734 87	4	Terminal, ring, insulated, ¼"
4	12 995 00	1	Cable tie (4½" long)
5	17 025 16	1	Heat shrink, clear, 0.125"
6	Reference only	2	14 AWG Teflon®[a] black wire (23" + 9¾")
7	Reference only	2	14 AWG Teflon® red wire (23" + 7¼")
8	Reference only	1	Clear vinyl sleeving, 0.0208" (3")
9	Reference only	1	Clear vinyl sleeving, 0.148" (5¼")
10	Reference only	2	Clear heat shrink sleeving, 0.188"

a. Teflon® is a registered trademark of E. I. du Pont and de Nemours and Company.

Heater Assembly—P/N 67 502 55-R

Figure 5-9. Heater Assembly—P/N 67 502 55-R

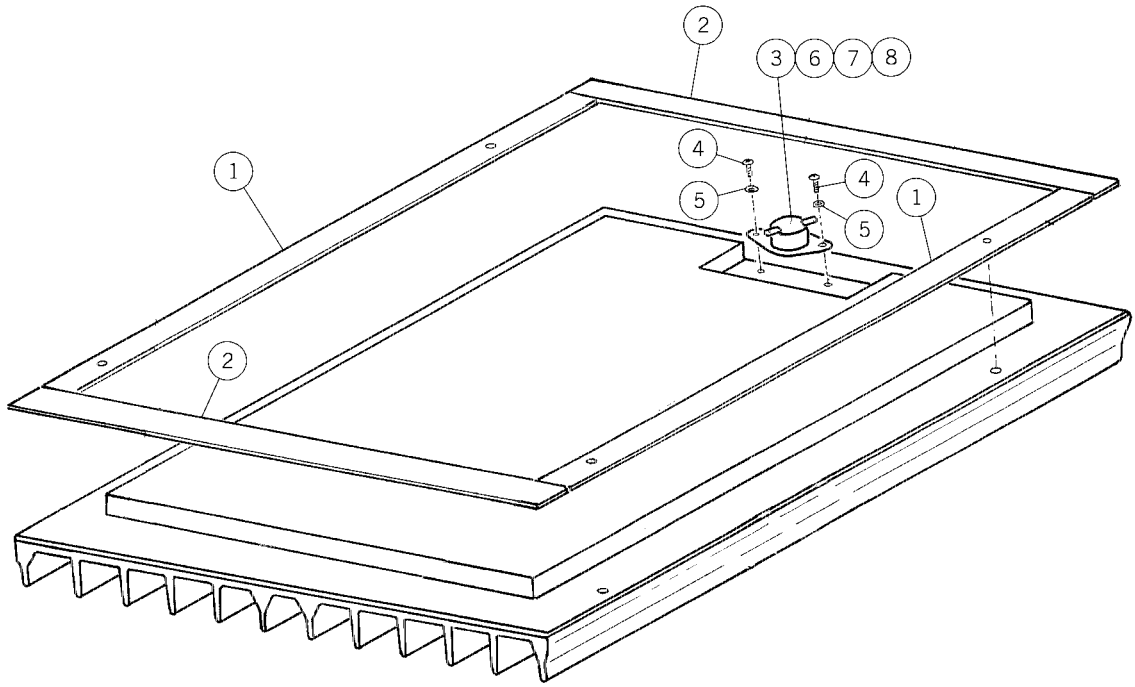

Table 5-9. Heater Assembly—P/N 67 502 55-R

Item Number	Part Number	Quantity	Description
1	67 001 08	2	Gasket, heat sink side
2	67 001 07	2	Gasket, heat sink end
3	17 BC 023	1	Thermostat, 175°F, 15A 120V AC
4	99 022 66	2	Screw, #6-32 x ¼", round phillips stainless steel
5	99 122 15	2	Washer, lock, spiral, #6
6	17 733 79	1	Connector housing, plug, four-position (0.197")
7	17 735 02	1	Contact, connector, female, 14 to 16 AWG
8	99 901 29	As required	Compound, thermal coupling

Incandescent Lamp Assembly—P/N 67 505 70

Figure 5-10. Incandescent Lamp Assembly—P/N 67 505 70

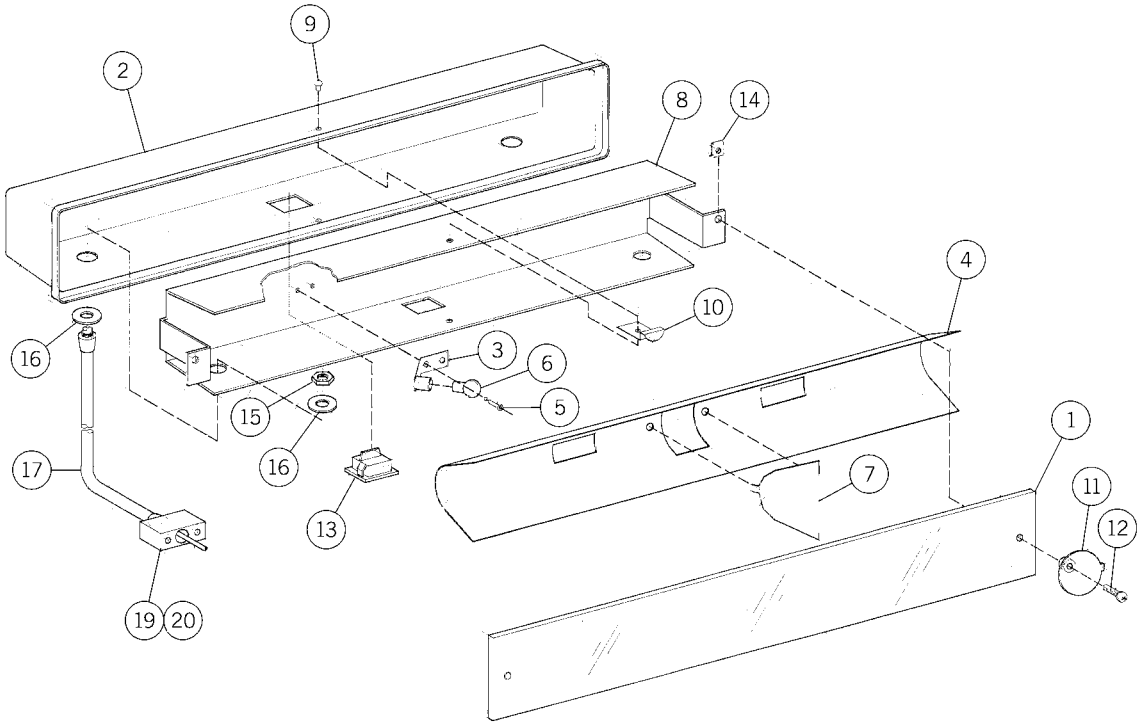

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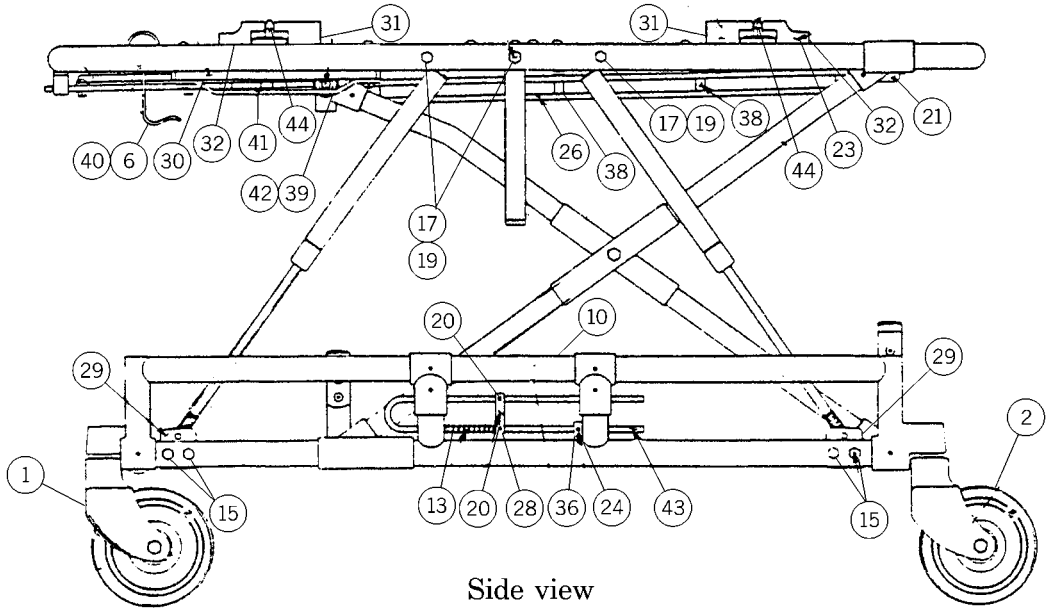
Table 5-10. Incandescent Lamp Assembly—P/N 67 505 70

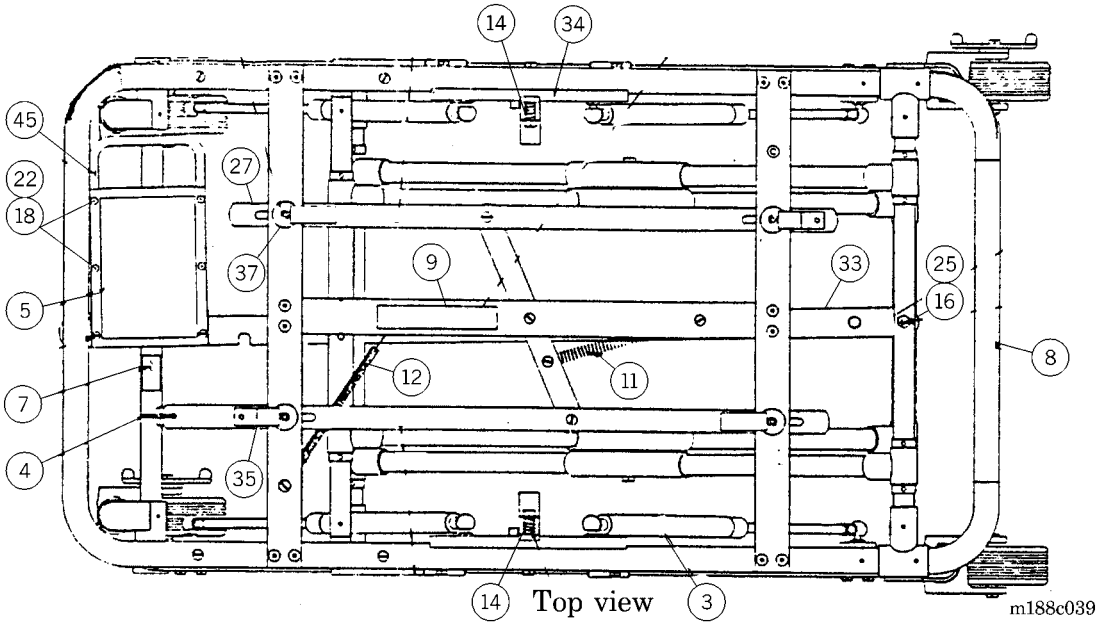
Item Number	Part Number	Quantity	Description
1	67 080 05	1	Panel, diffuser
2	67 505 02	1	Housing, lamp
3	67 505 30	1	Lamp holder assembly
4	67 505 00	1	Reflector
5	99 132 71	1	Rivet, pop, dome, 5/32" x 0.29" long, aluminum
6	17 806 92	1	Lamp, incandescent, G-6, DC bayonet, 6.5V
7	67 505 03	1	Reflector, auxiliary
8	67 505 01	1	Bracket, lamp support
9	99 131 02	1	Rivet, oval, 1/8" x 3/16" stainless steel
10	67 080 10	1	Retainer, diffuser
11	68 421 66	2	Suction cup, modified
12	99 033 15	2	Screw, #8-32 x 7/8", truss phillips stainless steel
13	17 682 63	1	Switch, rocker, 16 A 250V, high
14	99 106 66	2	Nut, #8-32
15	99 115 25	2	Nut, hex, 1/8"-27, nickel
16	99 126 93	4	Washer, lock, internal, 3/8" zinc
17	67 505 05	2	Arm, flexible, white
18	67 080 08	1	Block, mounting, lamp (not shown)
19	67 505 35	2	Wire set, lamp assembly
20	17 BR 558	2	Connector housing, plug, three-position (0.165")

Model HLS-101 Adjustable Stand—P/N 67 090 72 (Accessory)

Figure 5-11. Model HLS-101 Adjustable Stand—P/N 67 090 72 (Accessory)



Side view



Top view

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Table 5-11. Model HLS-101 Adjustable Stand—P/N 67 090 72 (Accessory)

Item Number	Part Number	Quantity	Description
1	03 501 21	2	Caster, 5.00", with brake
2	03 501 22	2	Caster, 5.00", without brake
3	03 501 14	4	Gas spring, 60 lb
4	03 500 66	1	Split ring
5	03 500 87	1	Label, handle instructions
6	03 500 89	1	Label, lock, handle, incubator
7	03 501 23	1	Label, style two stick-on identification
8	03 501 56	1	Label, raise/lower
9	03 501 17	1	Label, caution
10	03 501 24	1	Label, lock/unlock
11	03 501 25	1	Spring, tension
12	03 500 70	1	Spring, height adjustment
13	03 501 26	1	Spring, compression
14	03 501 27	2	Spring, compression
15	03 501 28	8	Bolt
16	03 501 29	10	Bolt
17	03 500 84	6	Bolt
18	03 501 30	6	Nut, lock, #10-24
19	03 500 86	6	Nut, 0.313"-18, lock, center hex
20	03 501 31	2	Roll pin, 0.188" x 1.00"
21	03 500 68	2	Screw, #10-24 x 0.625" round head machine
22	03 501 32	6	Screw, #10-24 x ¾"
23	03 501 33	4	Screw, ¼"-20 x ¾" slotted head cap
24	03 501 34	1	Setscrew, #10-24 x 0.19"
25	03 501 35	10	Washer, flat
26	03 501 36	1	Ratchet, stiffener
27	03 501 37	1	Bar, slide lock
28	03 501 38	1	Lock, 0.375" x 1¾" x 1¾" stop
29	03 501 39	4	Block, 0.625" x 1½" x 1.687"
30	03 501 40	2	Slide, 0.375" x 1" x 9" mount

Item Number	Part Number	Quantity	Description
31	03 501 41	4	Bracket, lock
32	03 501 42	4	Lock
33	03 501 43	1	Bar, ratchet
34	03 501 44	2	Clamp, ½" x 1" x 8.375"
35	03 501 45	1	Bar, lock
36	03 501 46	1	Release spacer rod
37	03 501 47	1	Washer
38	03 501 48	2	Spacer
39	03 501 49	2	Slide tube roller, 0.875" x 1.313"
40	03 501 50	2	Side clip, 0.125" x ¾" x 4.375"
41	03 501 51	2	Slide bar, 0.188" x 1" x 9.188"
42	03 501 52	2	Slide roller stem, 0.625" x 2.375"
43	03 501 53	2	Lock, safety kit
44	03 501 54	4	Pin, support guide
45	03 501 67	1	End release handle

NOTES:

IV Pole Assembly—P/N 67 091 80 (Accessory)

Figure 5-12. IV Pole Assembly—P/N 67 091 80 (Accessory)

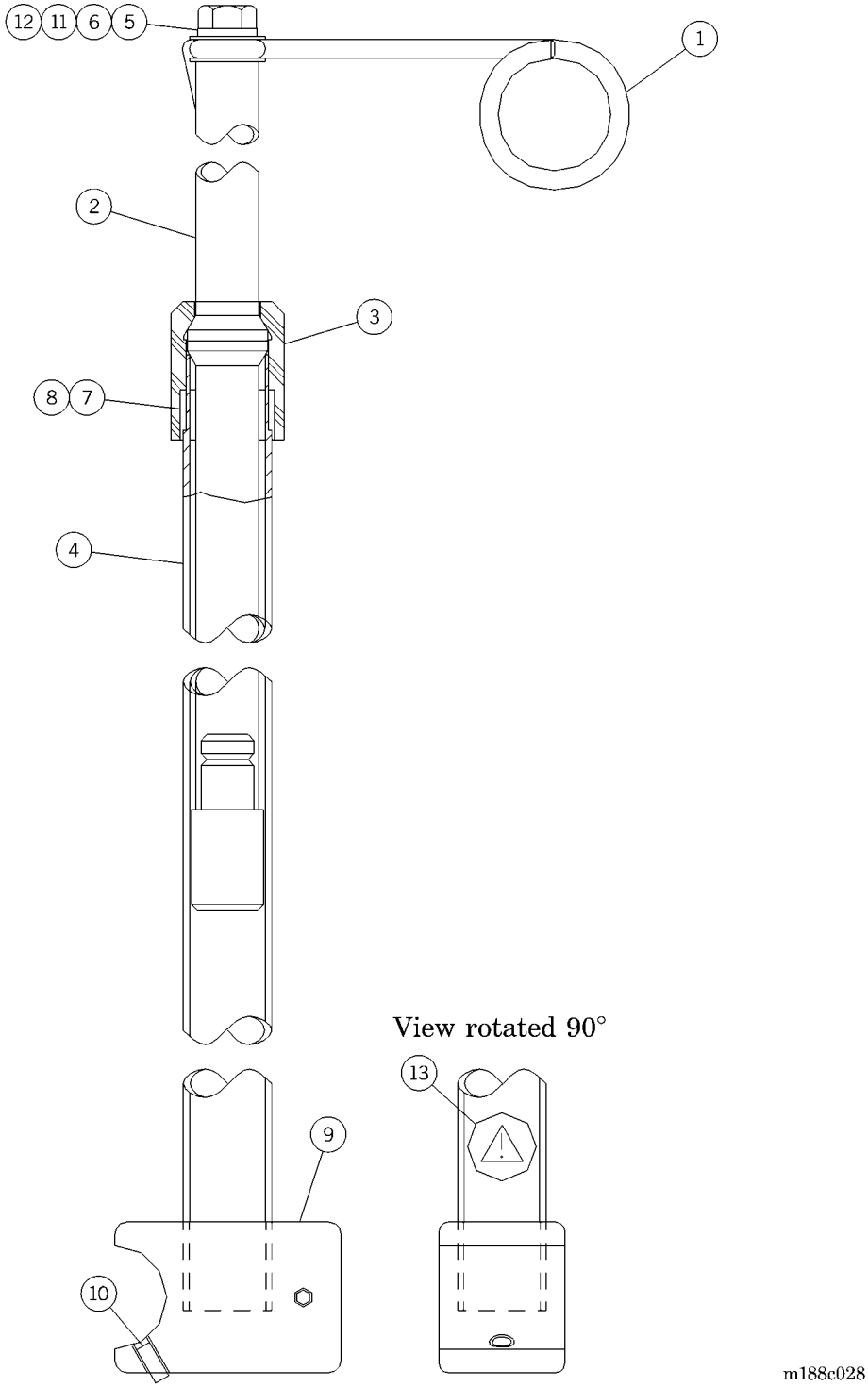

Table 5-12. IV Pole Assembly—P/N 67 091 80 (Accessory)

Item Number	Part Number	Quantity	Description
1	67 091 10	1	Arm, right angle, IV pole
2	67 091 09	1	Extension assembly, IV pole
3	26 821 00	1	Nut, locking, 7/8"-20 special
4	67 091 06	1	Pole, support, IV
5	99 064 50	1	Screw, 5/16"-18 x ¾" cap hex zinc
6	99 126 31	1	Washer, lock, internal, 5/16"
7	Reference only	As required	Compound, Molykote®[a] type Z
8	Reference only	As required	Lubricant, petrolatum
9	67 091 07	1	Block, mounting, IV pole
10	99 054 93	1	Screw, ¼"-20 x 3/8" socket stainless steel cap
11	Reference only	As required	Loctite®[b] screwlock #222
12	99 126 10	1	Washer, flat, 0.344" inner diameter ¾" outer diameter 0.05" thick stainless steel
13	68 160 05	1	Label, manual reference symbol

a. Molykote® is a registered trademark of Alpha Molykote Corporation.
b. Loctite® is a registered trademark of Loctite Corporation.

Accessory Shelf Kit—P/N 67 503 30 and 67 515 00/01/02/03/04/05 and Mount (Accessory)

Figure 5-13. Accessory Shelf Kit—P/N 67 503 30 and 67 515 00/01/02/03/04/05 and Mount (Accessory)

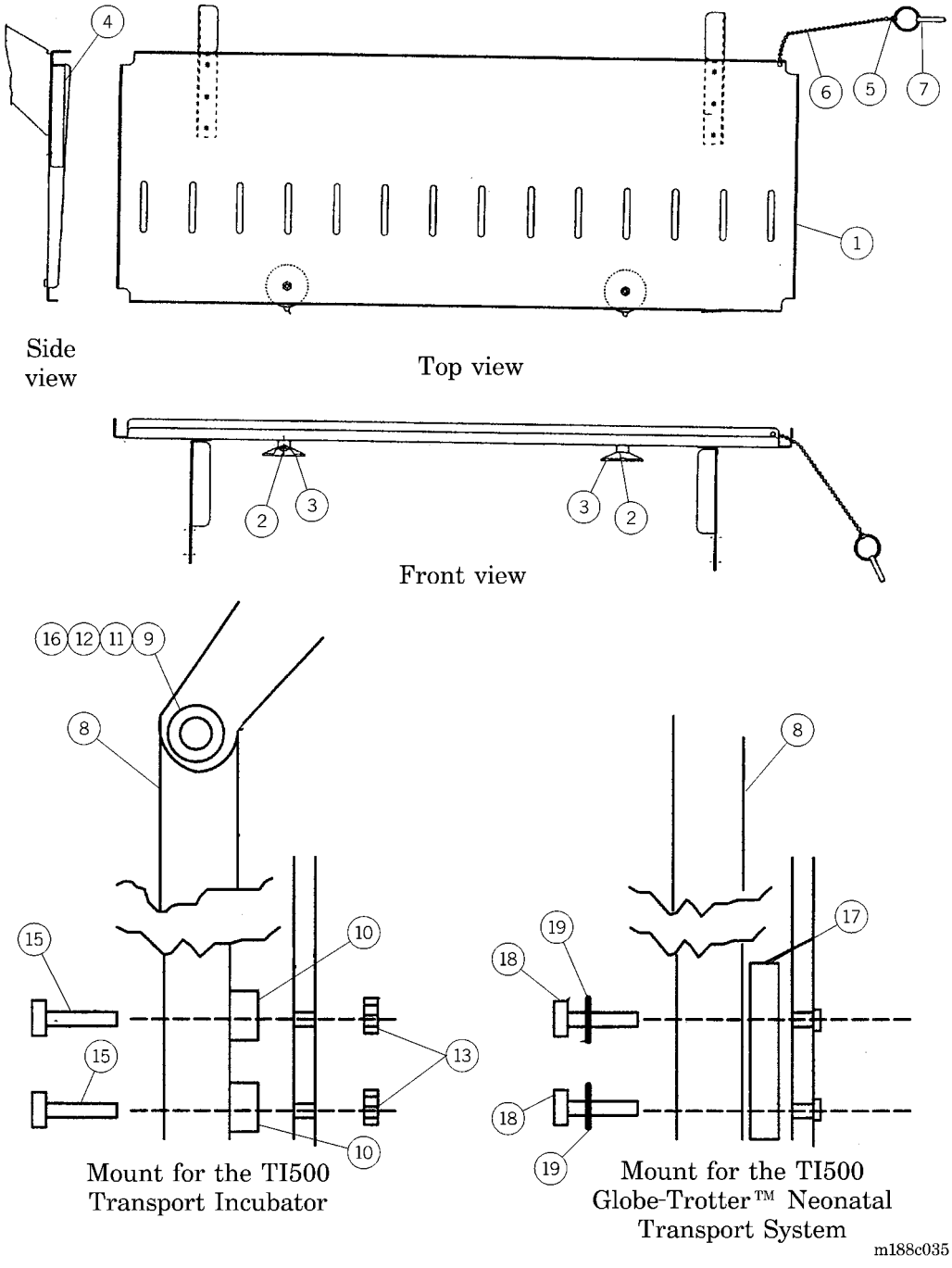

Table 5-13. Accessory Shelf Kit—P/N 67 503 30 and 67 515 00/01/02/03/04/05 and Mount (Accessory)

Item Number	Part Number	Quantity	Description
1	67 503 02	1	Shelf, accessory
2	99 023 92	2	Screw, #6-32 x ½", truss phillips stainless steel
3	68 421 66	2	Suction cup, modified
4	67 502 90	1	Label, caution, accessory shelf, English
5	26 662 05	1	Coupling, offset, bead chain
6	26 663 05	1	Bead chain, #6, 5½" long
7	78 166 05	1	Pin with ring, ball detent, 0.19" diameter x 1.00" long
8	67 503 01	1	Post, support, accessory shelf
9	67 092 15	1	Bushing (for use on the TI500 Transport Incubator only)
10	67 092 21	2	Spacer, 0.266" inner diameter ¾" outer diameter 0.31" long aluminum (for use on the TI500 Transport Incubator only)
11	99 042 01	1	Screw, #10-32 x ½" truss phillips stainless steel (for use on the TI500 Transport Incubator only)
12	99 123 32	1	Washer, flat, 0.19" inner diameter ¾" outer diameter 0.06" thick zinc (for use on the TI500 Transport Incubator only)
13	99 109 41	2	Nut, hex, ¼"-20 keps zinc (for use on the TI500 Transport Incubator only)
14	67 503 15-R	2	Replacement strap, tie-down, 60.00" long (not shown)
15	99 059 05	2	Screw, ¼"-20 x 1¾" cap hex (for use on the TI500 Transport Incubator only)
16	99 124 16	1	Washer, lock, spiral, #10 (for use on the TI500 Transport Incubator only)
17	67 503 65	1	Spacer (for use on the TI500 Globe-Trotter™ Neonatal Transport System only)

Item Number	Part Number	Quantity	Description
18	99 059 75	2	Screw, ¼"-20 x 2¼" cap hex (for use on the TI500 Globe-Trotter™ Neonatal Transport System only)
19	99 125 54	2	Washer, lock, internal, ¼" stainless steel (for use on the TI500 Globe-Trotter™ Neonatal Transport System only)

NOTES:

Controller P.C. Board Assembly (PCB1)—P/N 67 509 71

Figure 5-14. Controller P.C. Board Assembly (PCB1)—P/N 67 509 71

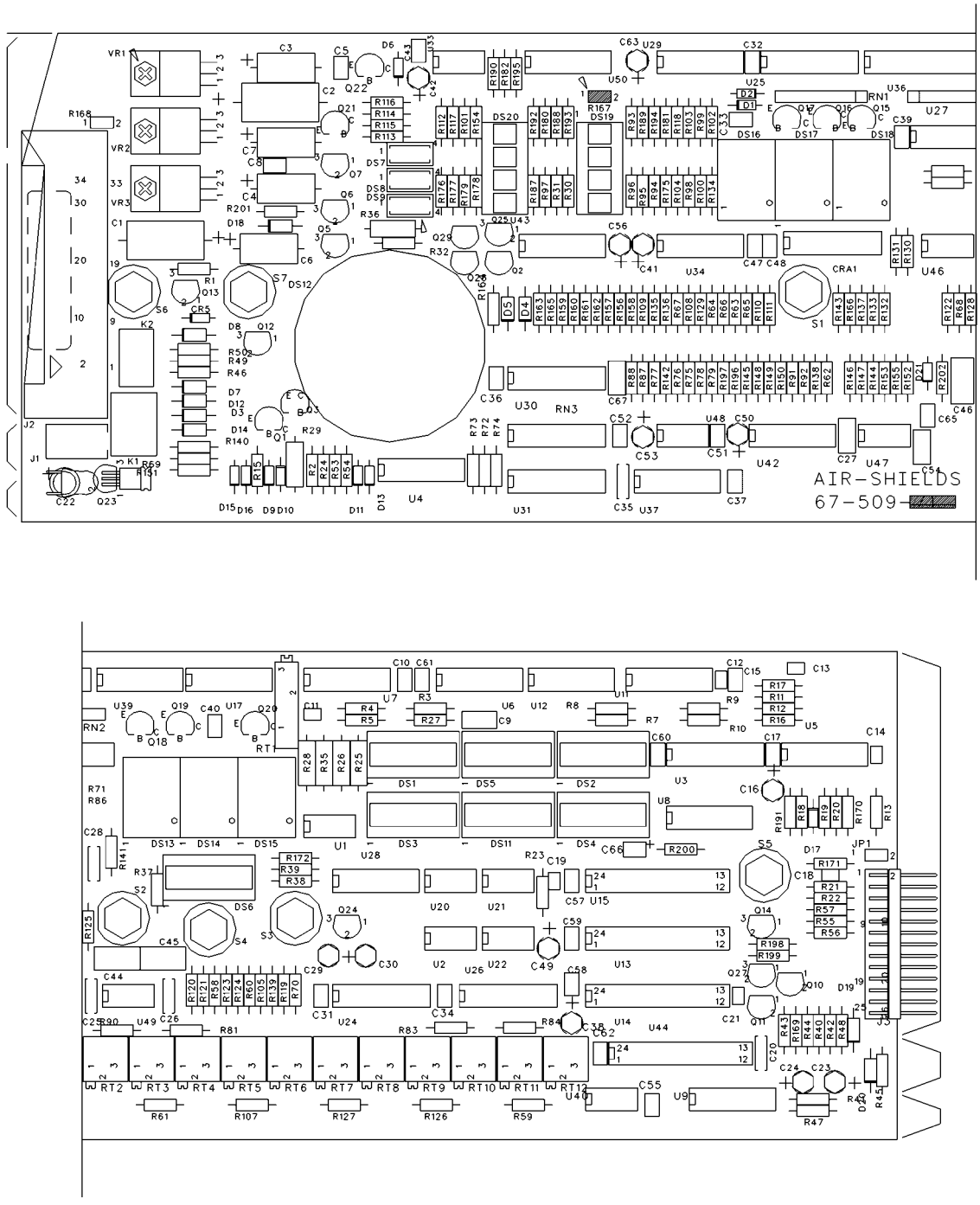

Table 5-14. Controller P.C. Board Assembly (PCB1)—P/N 67 509 71

Component Symbol	Part Number	Description
C1, C2	17 AW 567	Capacitor, 47 mF, +50-10%, 25V
C3	17 BF 565	Capacitor, 470 mF, 20%, 10V
C4, C6, C7	17 AW 534	Capacitor, 10 mF, +50-10%, 25V
C5, C8, C10, C14, C15, C17, C31 through C34, C36, C37, C39, C40, C43, C47, C48, C51, C52, C55, C57 through C62, C65	17 BF 217	Capacitor, 0.10 mF, 20%, 50V
C9, C27, C64, C67, C68	17 BF 222	Capacitor, 0.47 mF, 20%, 50V
C11 though C13, C18, C19, C21	17 BF 388	Capacitor, 0.010 mF, +80 -20%, 50V
C16, C23, C24, C29, C38, C41, C42, C50, C53	17 AW 212	Capacitor, 1.0 mF, 10%, 35V
C20, C25, C26, C28	17 AY 704	Capacitor, 0.0010 mF, 10%, 50V
C22	17 AW 244	Capacitor, 22 mF, 10%, 15V
C35	17 AY 700	Capacitor, 470 pF, 10%, 50V
C30, C49	17 AW 205	Capacitor, 0.27 mF, 10%, 50V
C44 through C46, C54	17 BF 224	Capacitor, 1.0 mF, 20%, 50V
C56, C63	17 AW 236	Capacitor, 10 mF, 10%, 25V
C66	17 AW 224	Capacitor, 4.7 mF, 10%, 35V
CR5	17 502 50	Diode, zener, 5.1V, 5%, 0.5 w
CRA1	17 502 70	Diode array, 16 dip
D1, D2, D6, D9 through D11, D13, D15 through D17	17 AR 500	Diode, silicon, switching
D3 through D5, D7, D8, D14, D18 through D20	17 AS 000	Diode, rectangle, silicon
D12	17 502 74	Diode, rectangle, auxiliary load, 1 A, 60V
D21	17 502 60	Diode, zener, 5.6V
DS1 through DS5, DS11	17 BE 241	Lamp, LED, rectangle, 16 dip, red

Component Symbol	Part Number	Description
•DS1 through DS6, DS11, DS19, DS20	17 735 25	Socket, integrated circuit, 16 dip, 0.210" high
•DS1 through DS6, DS11, DS19, DS20	17 BD 052	Spacer, single in-line mount, 0.03" thick
DS6	17 BE 240	Lamp, LED, rectangle, 16 dip, green
DS7 through DS9	17 807 34	Lamp, LED, rectangle (light bar), green
•DS7 through DS9	17 BP 858	Socket, single row, 0.275" high, four-position
DS12	68 903 89	Audio transducer replacement kit, high
DS13 through DS18	17 808 19	Display, LED, seven segments, 0.56 high, yellow
•DS13 through DS18	17 BP 834	Socket, single-row, 0.175" high, 15-position
DS19	17 BE 252	Lamp, LED, rectangle, four segments, 16 dip, yellow
DS20	17 BE 250	Lamp, LED, rectangle, four segments, 16 dip, green
J1	17 BS 470	Connector, P.C. header, single, two-pin
J2	17 BS 564	Connector, P.C. header, rectangle, double, 34-pin
J3	17 BP 895	Connector, P.C. header, double-row, rectangle, 26-position
JP1	17 BP 335	Connector, P.C. header, double row, two-position
•JP1	17 731 98	Connector, jumper plug, female, two-position
K1	17 BA 187	Relay, 5V 1 A, switching, plzd dpdt
K2	17 BA 198	Relay, high, P.C. mounting, 5V, coil
Q1, Q15 through Q20, Q22	17 627 46	Transistor, pnp
Q2, Q5 through Q7, Q10 through Q14, Q23 through Q25, Q27 through Q29	17 627 94	Transistor, N-channel power, field-effect
Q3, Q21	17 627 38	Transistor, npn
R1	17 AF 080	Resistor, 68.1 1% 1/8 w, film

Component Symbol	Part Number	Description
R2, R4, R8, R9, R11, R15, R17, R19, R23, R24, R32, R44, R45, R47 through R50, R55 through R58, R60, R63, R66, R68, R72, R73, R91, R108, R111 through R113, R118, R132, R134, R135, R141, R143, R144 through R146, R156, R157, R166, R181, R191, R196, R197, R203	17 AF 288	Resistor, 10.0K 1% 1/8 w, film
R3	17 AF 330	Resistor, 27.4K 1% 1/8 w, film
R5, R7, R10, R12, R13, R21, R37, R38, R41 through R43, R54, R55, R70, R74, R75, R78, R83, R87, R88, R101 through R104, R136, R169, R170	17 AF 384	Resistor, 100K 1% 1/8 w, film
R16	17 AF 449	Resistor, 475K 1% 1/8 w, film
R18, R67, R109, R110, R133, R192 through R195	17 AF 480	Resistor, 1.00M 1% 1/8 w, film
R20, R54	17 AF 537	Resistor, 3.92M 1% 1/8 w, film
R22, R39	17 AF 257	Resistor, 4.75K 1% 1/8 w, film
R25, R26, R35	17 AB 649	Resistor, carbon film, 56 5% ½ w
R27, R175	17 AF 096	Resistor, 100 1% 1/8 w, film
R28	17 AB 645	Resistor, carbon film, 39 5% ½ w
R29	17 AB 670	Resistor, carbon film, 470 5% ½ w
R30, R31	17 AF 105	Resistor, 124 1% 1/8 w, film
R36	17 AF 175	Resistor, 665 1% 1/8 w, film
R40, R200	17 AF 334	Resistor, 30.1K 1% 1/8 w, film
R45, R162	17 AF 267	Resistor, 6.04K 1% 1/8 w, film
R59, R61, R69	17 AF 251	Resistor, 4.12K 1% 1/8 w, film

Component Symbol	Part Number	Description
R62	17 AF 401	Resistor, 150K 1% 1/8 w, film
R64	17 AF 134	Resistor, 249 1% 1/8 w, film
R65	17 AF 164	Resistor, 511 1% 1/8 w, film
R71, R86	17 AF 107	Resistor, 130 1% 1/8 w, film
R76, R147	17 AF 413	Resistor, 200K 1% 1/8 w, film
R77	17 AF 442	Resistor, 402K 1% 1/8 w, film
R79	17 AF 225	Resistor, 2.21K 1% 1/8 w, film
R81	17 AF 264	Resistor, 5.62K 1% 1/8 w, film
R84, R119	17 AF 292	Resistor, 11.0K 1% 1/8 w, film
R90	17 AF 196	Resistor, 1.10K 1% 1/8 w, film
R92	17 AF 113	Resistor, 150 1% 1/8 w, film
R93 through R96, R176 through R179	17 AF 104	Resistor, 121 1% 1/8 w, film
R97, R99, R100	17 AF 184	Resistor, 825 1% 1/8 w, film
R98	17 AF 217	Resistor, 1.82K 1% 1/8 w, film
R105	17 AF 239	Resistor, 3.09K 1% 1/8 w, film
R107	17 AF 307	Resistor, 15.8K 1% 1/8 w, film
R114	17 AF 368	Resistor, 68.1K 1% 1/8 w, film
R115	17 AF 423	Resistor, 255K 1% 1/8 w, film
R116	17 AF 444	Resistor, 422K 1% 1/8 w, film
R117	17 AF 350	Resistor, 44.2K 1% 1/8 w, film
R120 through R122	17 AF 325	Resistor, 24.3K 1% 1/8 w, film
R123, R124, R163, R165	17 AF 260	Resistor, 5.11K 1% 1/8 w, film
R125, R139	17 AF 259	Resistor, 4.99K 1% 1/8 w, film
R126 through R128	17 AF 331	Resistor, 28.0K 1% 1/8 w, film
R129, R131, R171, R172, R199, R201, R202	17 AF 192	Resistor, 1.00K 1% 1/8 w, film
R130	17 AF 250	Resistor, 4.02K 1% 1/8 w, film
R137	17 AF 296	Resistor, 12.1K 1% 1/8 w, film
R138, R155	17 AF 238	Resistor, 3.01K 1% 1/8 w, film
R140	17 AF 000	Resistor, 10.0 1% 1/8 w, film

Component Symbol	Part Number	Description
R142	17 AF 221	Resistor, 2.00K 1% 1/8 w, film
R148, R164, R187	17 AF 317	Resistor, 20.0K 1% 1/8 w, film
R149	17 AF 346	Resistor, 40.2K 1% 1/8 w, film
R150	17 AF 327	Resistor, 25.5K 1% 1/8 w, film
R151	17 217 81	Resistor, 4300 0.05% 1/20 w, film
R152, R153	17 AF 430	Resistor, 301K 1% 1/8 w, film
R154	17 AF 229	Resistor, 2.43K 1% 1/8 w, film
R158	17 AF 381	Resistor, 93.1K 1% 1/8 w, film
R159	17 AF 313	Resistor, 18.2K 1% 1/8 w, film
R160, R161	17 AF 279	Resistor, 8.06K 1% 1/8 w, film
R180	17 AF 324	Resistor, 23.7K 1% 1/8 w, film
R182	17 AF 341	Resistor, 35.7K 1% 1/8 w, film
R188 through R190	17 AF 231	Resistor, 2.55K 1% 1/8 w, film
R198	17 AF 178	Resistor, 715 1% 1/8 w, film
RN1, RN2	17 AU 226	Resistor network, 4 each, 10K 2%, 0.300 w
RN3	17 217 64	Resistor network, 100K/200K 2% 0.05 w
RT1	17 AN 292	Variac®[a] resistor, 50K 1.25 w
RT2, RT3, RT6 through RT8, RT10, RT142	17 AN 121	Resistor, 2K 0.5 w, P.C. board horizontal adjustment
RT4, RT12	17 AN 133	Resistor, 50K 0.5 w, P.C. board horizontal adjustment
RT5, RT9, RT11	17 AN 127	Resistor, 10K 0.5 w, P.C. board horizontal adjustment
S1 through S7	17 682 47	Switch, 0.01 A 35V DC
U1, U2, U20, U21, U22	17 629 52	Integrated circuit, power driver
U3	17 631 35	Integrated circuit, cmos, 14 bit, binary control
U4, U7, U17	17 629 92	Integrated circuit, cmos, hex inverter
U5, U39	17 629 75	Integrated circuit, 4 x 2 input nand
U6, U12	17 629 77	Integrated circuit, 4 x 2 input nand
U8, U9, U37	17 629 57	Integrated circuit, cmos, dual flip-flop

a. Variac® is a registered trademark of General Radio Company.

Component Symbol	Part Number	Description
U11	17 629 83	Integrated circuit, cmos, 3 x 3 input, nand
U13	67 509 40	Firmware, alarm
•U13 through U15, U44	17 AP 381	Socket, integrated circuit, P.C. board mounting, 0.165" high, 24-dip
U14	67 509 41	Firmware, silence
U15	67 509 42	Firmware, buzzer
U24, U26	17 631 80	Integrated circuit, analog/digital converter
U25, U27	17 631 82	Integrated circuit, seven segment decoder/driver
U28	17 630 76	Integrated circuit, cmos, quad switch
U29, U50	17 629 70	Integrated circuit, quad op amp
U30, U31	17 629 88	Integrated circuit, cmos, up/down control
U33	17 629 56	Integrated circuit, timer
U34, U42, U43	17 629 58	Integrated circuit, quad comparator
U36	17 633 42	Integrated circuit, cmos, trist oct bfr
U40	17 634 03	Integrated circuit, temperature transducer, +5V
U44	67 509 43	Firmware, setpoint
U46 through U49	17 634 04	Integrated circuit, dual reel to reel, op amp
VR1, VR2	17 AT 057	Regulator, voltage, 5V 1 A
•VR1 through VR3	99 010 56	Screw, #4-40 x ¼", truss phillips stainless steel
•VR1 through VR3	99 103 33	Nut, hex, #4-40 keps zinc
VR3	17 AT 022	Regulator, voltage, 8V 1 A

NOTES:

Power P.C. Board Assembly (PCB2)—P/N 67 508 70

Figure 5-15. Power P.C. Board Assembly (PCB2)—P/N 67 508 70

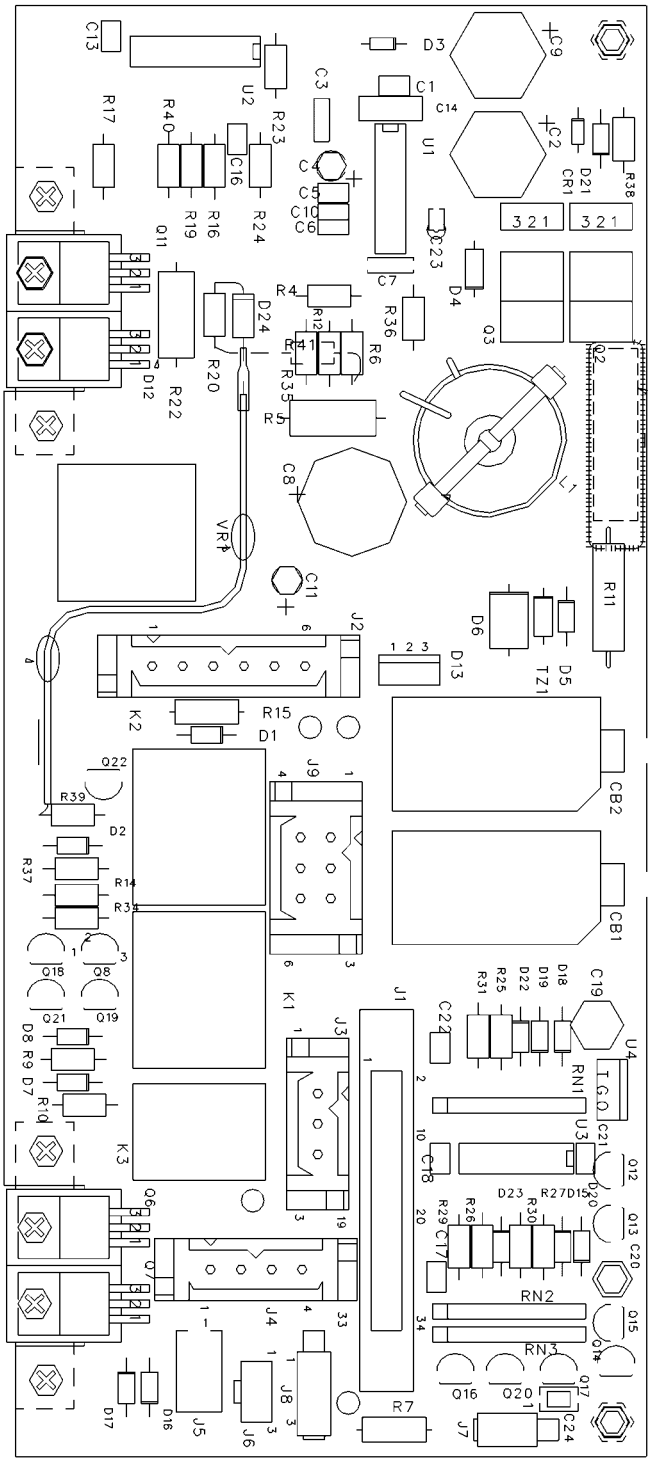

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Table 5-15. Power P.C. Board Assembly (PCB2)—P/N 67 508 70

Component Symbol	Part Number	Description
C1, C5, C13, C16 through C18, C21, C22	17 BF 217	Capacitor, 0.10 mF 20% 50V
C2, C9	17 BF 484	Capacitor, 1000 mF 20% 63V
C3,C14	17 AY 135	Capacitor, 0.068 mF 10% 100V
C4, C11	17 AW 212	Capacitor, 1.0 mF 10% 35V
C6	17 AY 710	Capacitor, 0.0033 mF 10% 50V
C8	17 BF 509	Capacitor, 2200 mF 20% 10V
C10	17 BF 429	Capacitor, 820 pF 10% 100V
C16	17 AY 704	Capacitor, 0.001 mF 10% 50V
C19	17 AW 235	Capacitor, 10 mF 10% 50V
C20	17 AW 236	Capacitor, 10 mF 10% 25V
C23	17 BF 365	Capacitor, 100 pF 10% 50V
C24	17 BF 224	Capacitor, 1.0 mF 20% 50V
CB1, CB2	17 BH 175	Circuit breaker, special, thermistor, 15 A, 240V/28V
CR1	17 502 50	Diode, zener, 5.1V 5% 0.5 w
D1, D2, D5, D7, D8, D15 through D23	17 AS 000	Diode, rectangle, silicon
D3	Reference only	Diode
D4	17 502 74	Diode, rectangle, auxiliary load, 1 A, 60V
D6	17 AR 513	Diode, silicon, switching
D12, D13	17 502 73	Diode, rectangle, power, 30 A 35V
•D12	17 061 19	Insulator, transistor, thermally-conduct
•D12	67 508 50	Heat sink, custom aluminum block
•D12	99 121 52	Washer, shoulder, 0.12" inner diameter
•D12	99 010 76	Screw, #4-40 x 5/16", truss phillips stainless steel
•D12	99 999 72	Washer, ribbed spring, S3 zinc
D24	17 AR 500	Diode, silicon, switching
J1	17 BS 533	Connector, P.C. holder, double, 34-pin
J2	17 BS 497	Connector, P.C. holder, single, vertical, six-position

Component Symbol	Part Number	Description
J3	17 BS 495	Connector, P.C. holder, single, vertical, three-position
J4	17 733 83	Connector, receptacle, male, P.C. thermistor, four-position
J5	17 BS 470	Connector, P.C. holder, single, two-pin
J6	17 BR 851	Connector, P.C. holder, single, three-position
J7	17 BS 515	Connector, P.C. holder, single, two-pin
J8	17 BS 516	Connector, P.C. holder, single, three-pin
J9	17 BS 505	Connector, P.C. holder, double, six-pin
K1, K2	17 BA 215	Relay, 40 A switching, 12V
K3	17 BA 207	Relay, 15 A switching, 6V
L1	17 585 19	Inductor, 55 µH, 5.0A, bare coil
•L1	12 995 00	Cable tie (4½" long)
Q2, Q11	17 628 13	Transistor, P-channel, power, field-effect
Q3, Q6, Q7	17 628 17	Transistor, power, field-effect
•Q6, Q7, Q11	17 061 19	Insulator, transistor, thermally-conduct
•Q6, Q7, Q11	67 508 50	Heat sink, custom aluminum block
•Q6, Q7, Q11	99 121 52	Washer, shoulder, 0.12" inner diameter
•Q6, Q7, Q11	99 010 76	Screw, #4-40 x 5/16", truss phillips stainless steel
•Q6, Q7, Q11	99 999 72	Washer, ribbed spring, S3 zinc
Q8, Q12 through Q22	17 627 94	Transistor, N-channel, power, field-effect
R4, R6, R9, R10	17 AF 192	Resistor, 1.00K 1% 1/8 w, film
R5	17 AN 915	Resistor, 0.02Ω, 5% 3w, film
R7	17 AN 701	Resistor, 1.0Ω, 1%, 2 w, film
R11	17 217 73	Resistor, 200Ω, 5% 3.0 w, metal film
R12	17 AF 248	Resistor, 3.83K 1% 1/8 w, film
R14	17 AF 221	Resistor, 2.00K 1% 1/8 w, film
R15	17 AB 601	Resistor, carbon film, 22 5% ½ w
R16	17 AF 335	Resistor, 30.9K 1% 1/8 w, film

Component Symbol	Part Number	Description
R17	17 AF 441	Resistor, 392K 1% 1/8 w, film
R19	17 AF 313	Resistor, 18.2K 1% 1/8 w, film
R20	17 AF 397	Resistor, 137K 1% 1/8 w, film
R22	17 AN 916	Resistor, 0.084Ω, 5% 3w, film
R23, R34, R37 through R39, R41	17 AF 288	Resistor, 10.0K 1% 1/8 w, film
R24	17 AF 260	Resistor, 5.11K 1% 1/8 w, film
R25, R26	17 AF 384	Resistor, 100K 1% 1/8 w, film
R27, R29	17 AF 356	Resistor, 51.1K 1% 1/8 w, film
R30	17 AF 331	Resistor, 28.0K 1% 1/8 w, film
R31	17 AF 341	Resistor, 35.7K 1% 1/8 w, film
R35, R36	17 AF 096	Resistor, 100 1% 1/8 w, film
R40	17 AF 108	Resistor, 133 1% 1/8 w, film
RN1 through RN3	17 AU 227	Resistor network, five each, 10K 2% 0.300 w
TZ1	17 AR 343	Transzorb®[a], 28V, 500 W
U1	17 634 07	Integrated circuit, regulator, step-down, switching
U2	17 634 06	Integrated circuit, solid lead-acid battery charger
U3	17 629 58	Integrated circuit, quad comparator
U4	17 AT 060	Regulator, volt, 5V 1.5 A
VR1	17 AT 062	Regulator, switching, +12V, ¼ A
Reference only	17 732 28	Connector, receptacle, male, recessed, AC power
Reference only	17 025 11	Heat shrink, black, 0.023" inner diameter
Reference only	99 116 92	Standoff, P.C. board, flare, #6-32 x ¼" stainless steel
Reference only	99 901 90	Bag, static shield, clear, 6" x 10"
Reference only	99 120 01	Spacer, 0.032" inner diameter 0.12" outer diameter 0.12" long nylon

a. Tranzorb® is a registered trademark of General Semiconductor, Inc.

NOTES:

Chapter 6
General Procedures

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6

NOTES:

Cleaning

SHOCK HAZARD:
Follow the product manufacturer's instructions. Failure to do so could result in personal injury or equipment damage.

WARNING:
When performing cleaning and maintenance procedures, ensure that the oxygen supply to the incubator is turned off and that the incubator is disconnected from the oxygen supply. A fire and explosion hazard exists when cleaning and maintaining the incubator in an oxygen-enriched environment.

SHOCK HAZARD:
Unplug the unit from its power source. Failure to do so could result in personal injury or equipment damage.

SHOCK HAZARD:
To disconnect the batteries from the incubator, loosen the battery compartment fastening knob, and slide the compartment out approximately 5 cm (2"). Failure to do so could result in personal injury or equipment damage.

SHOCK HAZARD:
Do not expose the unit to excessive moisture that would allow for liquid pooling. Personal injury or equipment damage could occur.

CAUTION:
Do not use harsh cleaners/detergents, such as scouring pads and heavy duty grease removers, or solvents, such as toluene, xylene, and acetone. Equipment damage could occur.

At a minimum, thoroughly clean and disinfect the incubator upon discharge of an infant. However, depending on individual facility policy, clean and disinfect as often as daily, if desired. The most effective way to clean is to first disassemble, and then group the parts and/or assemblies in categories according to the method of cleaning required (see "Disassembly, Cleaning, and Assembly" on page 6-5).

If there is no visible soilage with possible body fluids, we recommend that you clean the unit with a mild detergent and warm water. If disinfection is desired, you may use a combination cleanser/disinfectant as explained in “Disinfecting” on page 6-4.

Steam Cleaning

Do not use any steam cleaning device on the unit. Excessive moisture can damage mechanisms in this unit.

Cleaning Hard to Clean Spots

To remove difficult spots or stains, we recommend that you use standard household cleansers and a soft-bristled brush. To loosen heavy, dried-on soil, you may first need to saturate the spot.

Disinfecting

When there is visible soilage and between patients, we recommend that you disinfect the unit with a tuberculocidal disinfectant, such as Kleenaseptic®[1] Germicidal Cleanser. (For customers in the US, the disinfectant should be registered with the Environmental Protection Agency.)

Dilute the disinfectant according to the manufacturer's instructions.

1. Kleenaseptic® is a registered trademark of Predicted Environments, Inc.

6.1 Disassembly, Cleaning, and Assembly

Tools required: Detergent/disinfectant
Clean cloth or paper towels
Warm water
General purpose gloves

Disassembly

1. Remove the access door cuffs (A) and access port gaskets (B) (see figure 6-1 on page 6-6). Discard the access door cuffs (A).

2. To remove the iris entry port sleeve (C), pull it off the retainer rings (D) of the port housing (X). Discard the iris entry port sleeves (C).

3. Unlatch the front and head end access panels (E), and open them until they hang down on the handrail (F) (see figure 6-2 on page 6-7).

4. Grasp the center of each tubing access grommet (G), and remove them from the access ports.

5. Remove the mattress tray (H) by following these steps:
   a. Slide the mattress tray (H) to the left until it reaches its mechanical stop (I).
   b. Remove the mattress (J) from the mattress tray (H).
   c. Press the mechanical stop (I), and slide the mattress tray (H) off of the upper shell (K).

6. Remove the hood (L) by following these steps:
   a. Close and latch the access panels (E).
   b. Release the hood retainers (Y) located at the front and end of the incubator.
   c. Carefully lift the hood (L) straight up, and set it aside.
   d. Remove the inner hood (Z), and set it aside (see figure 6-1 on page 6-6).

7. Remove the upper shell (K) by following these steps (see figure 6-2 on page 6-7):
   a. Remove the humidity sponge (M), and discard.
   b. Release and pull back the four shell latches (N) at the head and foot end of the incubator.

Figure 6-1. Hood Assembly

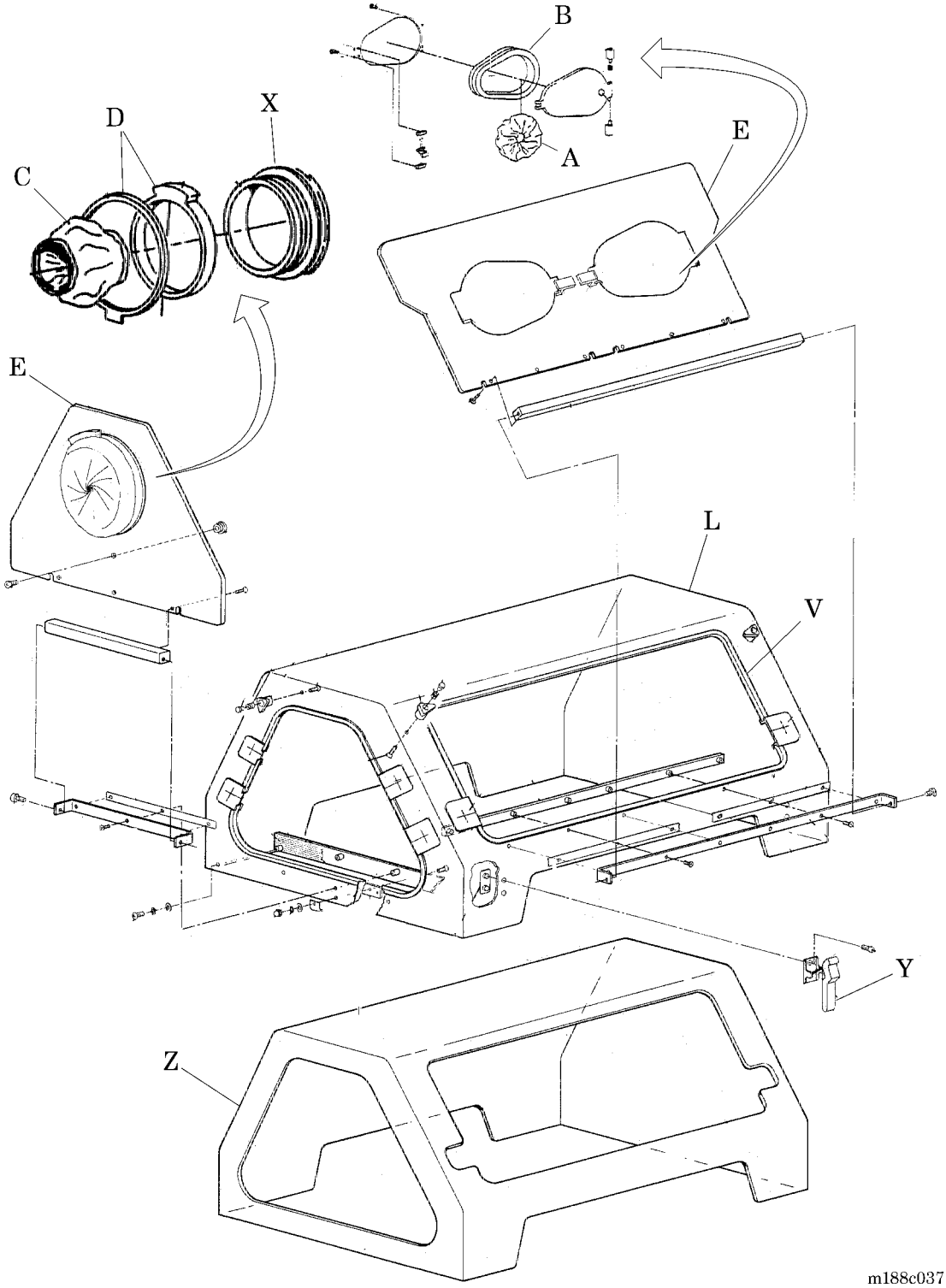
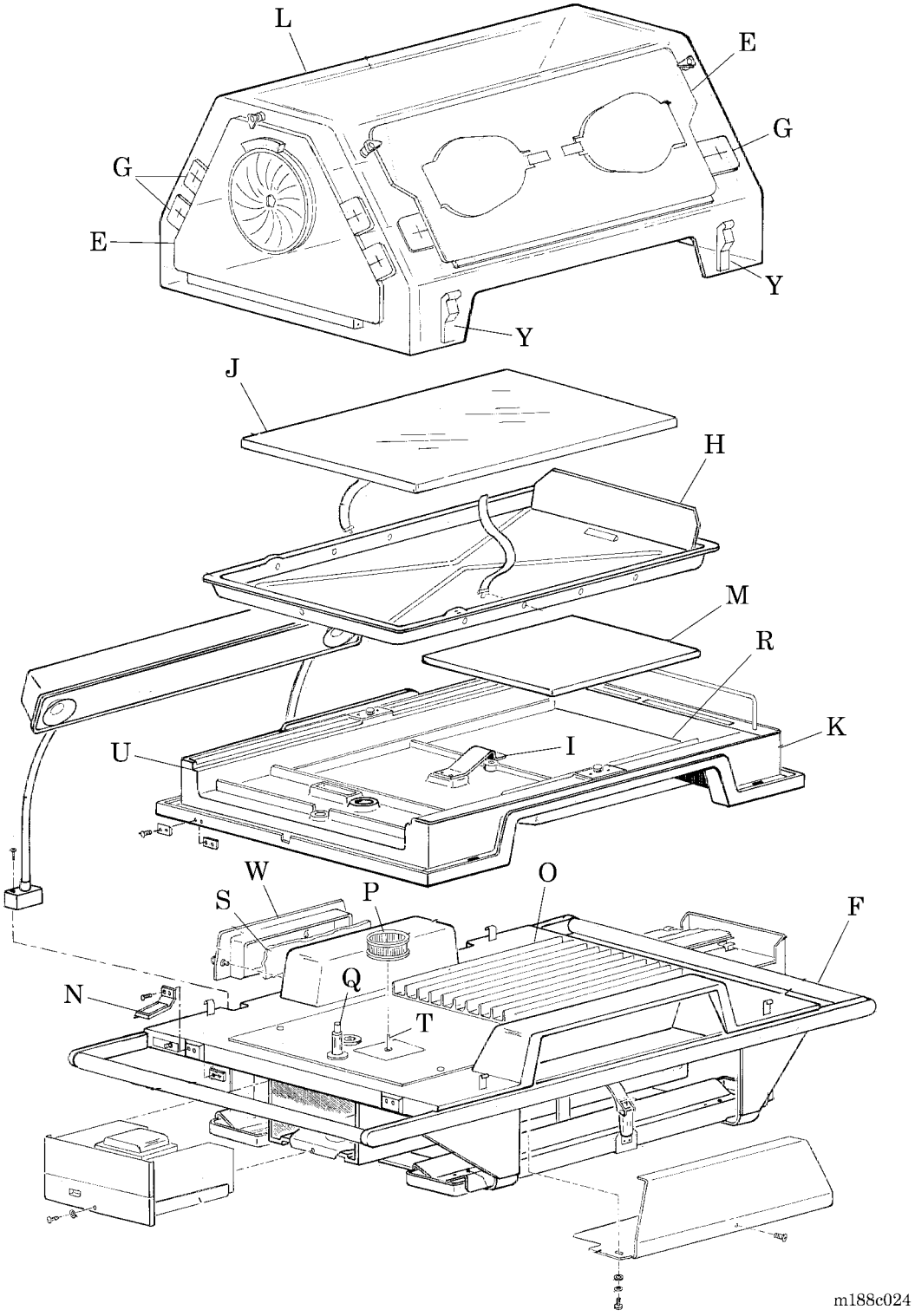


Figure 6-2. Transport Incubator



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c. Lift the upper shell (K) straight up.

Cleaning

1. Put on the general purpose gloves.

2. Remove all solid wastes and contaminants from the disassembled parts. See “Cleaning” on page 6-3.

3. Every 3 to 4 months during routine service or maintenance, or when overt contamination is known or suspected, perform the following to clean the lower shell:

WARNING:
The heater fins may be hot enough to burn. Do not touch the heater fins until the unit has cooled for at least 30 minutes.

   a. Remove any lint from the heater fins (O), fan motor impeller (P), and air temperature probe (Q) (see figure 6-2 on page 6-7).

   b. Wipe the heater fins (O), air temperature probe (Q), fan motor impeller (P), and adjacent surfaces with a clean cloth or paper towel moistened with the detergent/disinfectant solution.

   c. Allow the heater fins (O), air temperature probe (Q), fan motor impeller (P), and adjacent surfaces to air dry.

4. Clean the humidity chamber (R) and upper shell (K):

   a. Using a detergent/disinfectant, thoroughly clean all surfaces of the humidity chamber (R) and upper shell (K).

   b. Using a clean cloth or paper towel, dry the humidity chamber (R) and upper shell (K).

   c. Inspect the black rubber gasket on the underside of the upper shell (K) for damage.

5. Clean the mattress tray (H):

   a. Using a detergent/disinfectant, clean all surfaces of the mattress tray (H).

   b. Using a clean cloth or paper towel, dry the mattress tray (H).

6. Clean the hood (L) and adjustable stand assembly:

CAUTION:
Do not use alcohol, acetone, or any organic solvents for cleaning. They could craze the clear acrylic hood.

CAUTION:
Do not expose the hood assembly to direct radiation from germicidal lamps. Ultraviolet radiation from these sources could crack gaskets, fade paint, and craze the clear acrylic hood.

a. Using a detergent/disinfectant, thoroughly clean all surfaces of the hood (L) and adjustable stand assembly, including the inner wall (Z) and access panels (E) (see figure 6-1 on page 6-6). Clean all holes, indentations, and baffles.

b. Using a clean cloth or paper towel, dry the hood (L) and adjustable stand assembly.

7. Clean the tubing access grommets (G) (see figure 6-2 on page 6-7):

   a. Using a detergent/disinfectant, thoroughly clean the six tubing access grommets (G).

   b. Rinse the six tubing access grommets (G) with warm water.

   c. Using a clean cloth or paper towel, dry the six tubing access grommets (G).

WARNING:
A dirty air intake filter could affect oxygen concentration or cause carbon dioxide build-up. Check the air intake filter on a routine basis commensurate with local conditions. Failure to do so could result in personal injury or equipment damage.

8. Remove the general purpose gloves, and wash your hands.

9. Do not attempt to clean or reverse the air intake filter (S). If the air intake filter (S) becomes wet, is visibly dirty, or is older than 3 months, replace it.

Assembly

CAUTION:
To avoid damage to the air temperature probe, exercise care when lowering the upper shell onto the lower shell.

1. Align the air temperature probe (Q) with the hole in the upper shell (K).
2. Secure the four shell latches (N) at the head and foot ends of the incubator.

WARNING:
After cleaning, install the impeller on the motor shaft. Failure to do so could cause the heater to overheat and become disabled. If the impeller is installed incorrectly, oxygen and temperature could be adversely affected. Ensure that the impeller turns freely after installation.

3. Install the fan motor impeller (P) on the motor shaft (T). Ensure that it is approximately 16 mm (1/16") from the cover and rotates freely.
4. Place a new humidity sponge (M) in the humidity chamber (R).
5. Install the hood (L) on the upper shell (K).
6. Open the head end access panel (E).
7. Place the mattress (J), in its cover, in the mattress tray (H).
8. Place the mattress tray (H) on the left end of the upper shell (K), and then slide it to the right, under the mattress tray retainers (U) until it passes the mechanical stop (I) and stops at the right end of the upper shell (K).
9. Secure the hood retainers (Y).
10. Open the front and head end access panels (E).
11. Install an access port gasket (V) behind each access panel (E) (see figure 6-1 on page 6-6).
12. Install a new access door cuff (A) onto each access port gasket (B):
    a. Stretch the larger diameter elastic band into the groove in the access port gasket (B).
    b. Ensure that the access door cuff (A) has a small opening at its center.

13. Install a new, disposable, iris, entry port sleeve (C):
    a. Install the smaller diameter elastic band of the new, disposable, iris, entry port sleeve (C) over the inner retaining ring (D) of the port housing (X).
    b. Fold the elastic band back, and slip it over the outer retaining ring (D) of the port housing (X).
    c. To close the iris entry port sleeve (C), rotate the outer retaining ring (D) of the port housing (X).
    d. Ensure that the new, disposable, iris, entry port sleeve (C) opens again if rotation is reversed.
14. To install the tubing access grommets (G), insert them into the slots in the outer hood (L) (see figure 6-2 on page 6-7).
15. Close and latch the front and head end access panels (E).
16. If necessary, install a new air intake filter (S).
17. Install the air intake filter cover (W), and tighten its two thumbscrews.
18. If a new air intake filter (S) is installed, indicate the date on the place provided on the air intake filter cover (W).
19. Before returning the unit to service, perform “Function Checks and General Operation Checkout” on page 2-4.

Component Handling

CAUTION:
To prevent component damage, ensure that your hands are clean, and **only** handle the P.C. board by its edges.

CAUTION:
When handling electronic components, wear an antistatic strap. Failure to do so could result in component damage.

CAUTION:
For shipping and storage, place the removed P.C. board in an antistatic protective bag. Equipment damage can occur.

P.C. Board

When servicing the P.C. board, follow good handling practices. Mishandling a P.C. board can cause the following:

- P.C. board damage
- Shortened P.C. board life
- Unit malfunctions

Observe the following P.C. board handling rules:

- Ensure that hands are clean and free of moisture, oily liquids, etc.
- **Only** handle the P.C. board by its outer edges.
- Do not touch the P.C. board components. Finger contact with the board surface and/or with its components can leave a deposit that will result in board (and component) deterioration.
- When working with electronics, wear an appropriate antistatic strap, and ensure that it is properly grounded.
- Service the removed P.C. board at a static-free workstation that is properly grounded.
- For shipping and storage, place the removed P.C. board in an antistatic protective bag.

Lubrication Requirements

WARNING:
Follow the product manufacturer's instructions. Failure to do so could result in personal injury or equipment damage.

CAUTION:
Do not use silicone-based lubricants. Equipment damage could occur.

Oilite®[1] bearings and bushings are utilized in several places on the system. By retaining oil, the pores give a self-lubricating quality to the bearings and bushings. If any silicone-based lubricant is applied to the bearings and bushings or anywhere else on the system, this self-lubricating quality is neutralized.

It is safe to apply the following lubricants to the system (see table 6-1 on page 6-13):

Table 6-1. Lubricants

Part Number	Description
8252 (100)	2 oz m-1 oil (apply to Oilite® bearings and bushings)
SA3351 (100)	4 oz lithium grease

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1. Oilite® is a registered trademark of Beemer Precision, Incorporated.

Preventive Maintenance

WARNING:
Only facility-authorized personnel should perform preventive maintenance on the Transport Incubator. Preventive maintenance performed by unauthorized personnel could result in personal injury or equipment damage.

The Transport Incubator requires an effective maintenance program. We recommend that you perform annual preventive maintenance (PM) and testing for Joint Commission on Accreditation of Healthcare Organizations (JCAHO). PM and testing not only meet JCAHO requirements but will help ensure a long, operative life for the Transport Incubator. PM will minimize downtime due to excessive wear.

The following PM schedule guides you through a normal PM procedure on the Transport Incubator. During this PM process, check each item on the schedule, and make the necessary adjustments.

Follow the PM schedule with the corresponding PM checklist. This checklist is designed to keep a running maintenance history and subsequent repair costs for one Transport Incubator. However, your facility can modify this checklist or design another to fit your needs. Two effective ways to reduce downtime and ensure the patient remains comfortable are keeping close records and maintaining the Transport Incubator.

Preventive Maintenance Schedule

Table 6-2. Preventive Maintenance Schedule

Function	Procedure
Lower shell	Remove lint from the heater fins, fan motor impeller, and air temperature probe.
Upper shell	Inspect the black rubber gasket on the underside of the upper shell for damage.
Air intake filter	Inspect the air intake filter. If it is wet, visibly dirty, or older than 3 months, replace it.
Overall appearance	Check the general aesthetics of the incubator. Inspect the labels, and replace as necessary.

Preventive Maintenance Checklist

Table 6-3. Preventive Maintenance Checklist

Date																						**Function**
Hill-Rom	**Manufacturer**																					
																						Lower shell
																						Upper shell
																						Air intake filter
																						Overall appearance
	Model Number																					
	Serial Number																					
	Total Cost for this Page																					**Labor Time:**
																						Repair Cost:
																						Inspected by:
																						Legend L=Lube C=Clean A=Adjust R=Repair or Replace O=Okay N=Not Applicable Remarks:

6.2 Installation

Tools required: None

Unpacking

NOTE:
The hood and base assembly and the adjustable stand assembly are shipped in separate cartons.

1. Remove all packing materials.

CAUTION:
When removing the equipment from the cartons, take care not to scratch or otherwise damage unprotected surfaces.

2. Remove the equipment from the cartons. Take care not to scratch or otherwise damage unprotected surfaces.

CAUTION:
Do not release the frame retaining latches or raise the adjustable stand assembly until the incubator has been installed. Damage to the adjustable stand assembly could occur.

3. Do not release the frame retaining latches or raise the adjustable stand assembly until the incubator is installed (see “Assembly” on page 6-17).

Assembly

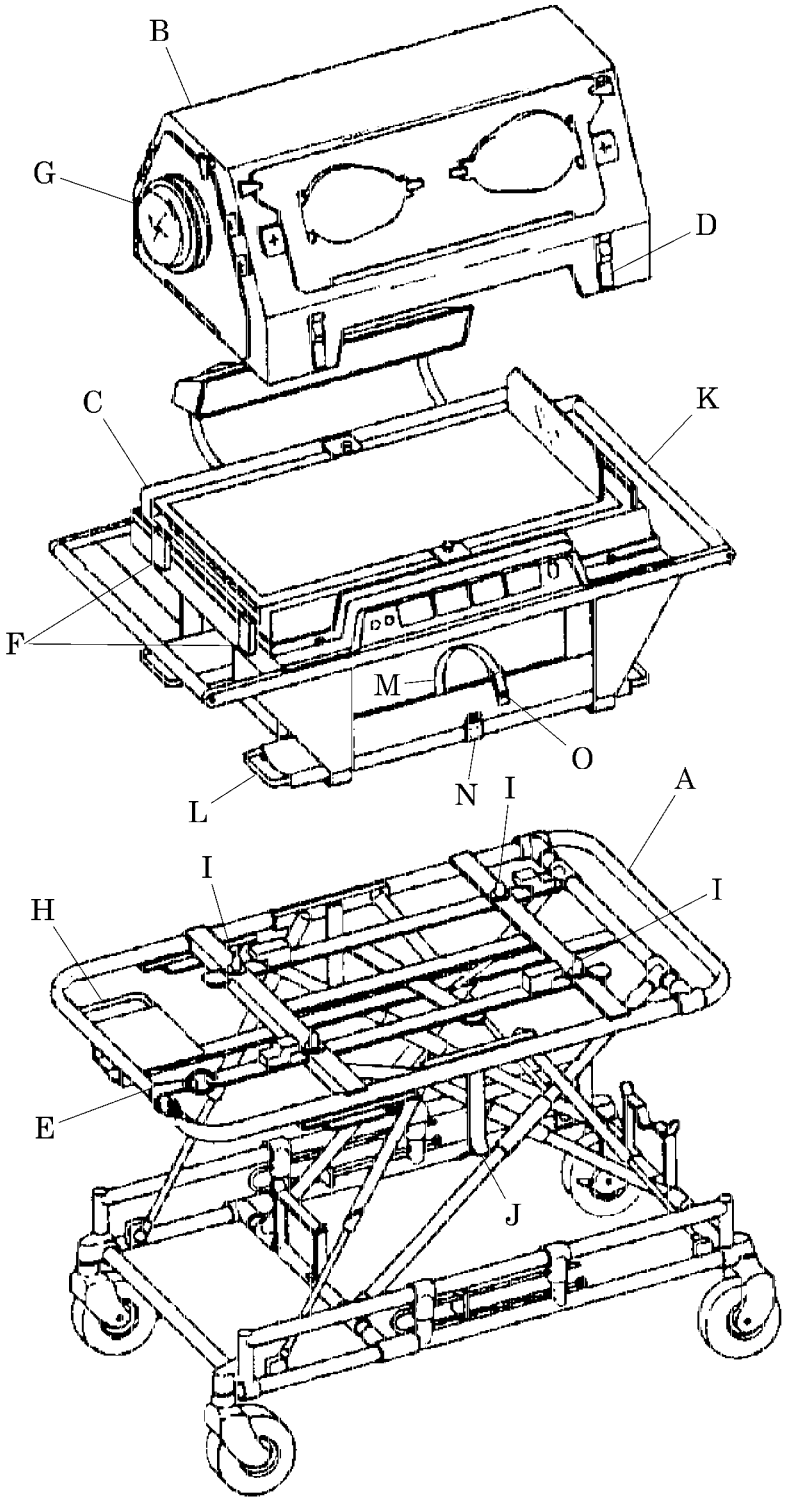
To install the Transport Incubator onto the accessory adjustable stand assembly (A), perform the following (see figure 6-3 on page 6-18):

WARNING:
To prevent personal injury, keep fingers clear of moving parts.

1. Install the hood (B) onto the base assembly (C). Ensure that all four hood retainers (D) secure the hood (B) to the base assembly (C).

2. Pull the incubator locking handle (E) to the **Unlock** position, and hook the retaining latches (F) of the base assembly (C) to the top frame of the adjustable stand assembly (A).

Figure 6-3. Assembly



WARNING:
Two people should always handle the Transport Incubator. Failure to do so could result in personal injury or equipment damage.

3. Position the hood (B) and base assembly (C) on the adjustable stand assembly (A).
   a. Ensure the end access door (G) faces the end of the adjustable stand assembly (A) with the height adjustment latch (H).
   b. Ensure that the base assembly (C) sits firmly on the alignment pins (I).
4. Release the retaining latches of the base assembly (C), and allow the incubator locking handle (E) to return to the **Lock** position.
5. Lift up on the base assembly (C) at both ends. Ensure that it is securely installed on the adjustable stand assembly (A).
6. Release the two frame retaining latches (J).
7. To raise the adjustable stand assembly (A), perform the following:
   a. With an attendant at each end, firmly grasp the four corners of the top frame of the adjustable stand assembly (A) with the palms of your hands upward.
   b. Lift the adjustable stand assembly (A) slightly to take the weight off of the height adjustment latch (H).
   c. Pull and hold the unlocking handle of the height adjustment latch (H) outward.
   d. Raise the adjustable stand assembly (A) to the desired position.

NOTE:
The integral gas springs on the adjustable stand assembly assist in supporting the weight of the incubator.

WARNING:
To ensure incubator stability, fully support the weight of the incubator until the height adjustment latch firmly locks in the desired position. Failure to do so could result in personal injury or equipment damage.

   e. Release the height adjustment latch (H), and continue raising the adjustable stand assembly (A) slightly until the height adjustment latch (H) engages with a click.

8. To lower the adjustable stand assembly (A), perform step 7 in reverse order.

9. When the adjustable stand assembly (A) is in the lowest position, latch the frame retaining latches (F) to the lower bar of the adjustable stand assembly (A).

10. To store the AC power cord and the external DC power cord, neatly wrap and hang them on the hand rail (K) using the Velcro®[1] strap.

SHOCK HAZARD:
Before use, check the continuity of the ground between the chassis and the AC plug grounding pin. Failure to do so could result in personal injury or equipment damage.

11. To connect the AC power cord and the external DC power cord to external power sources, perform the following:

SHOCK HAZARD:
To ensure grounding reliability, plug the AC power cord only into a properly grounded, three-wire, hospital-grade or hospital-use outlet of the proper voltage and frequency. Do **not** use extension cords. Personal injury or equipment damage could occur.

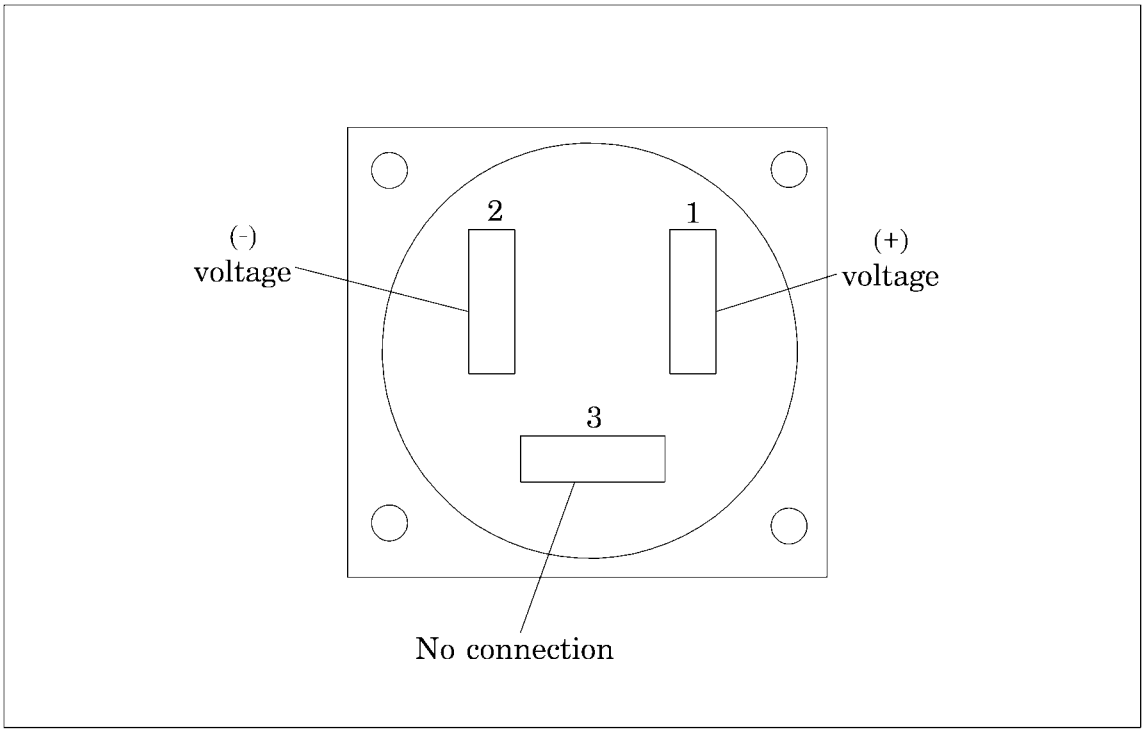
a. Plug the AC power cord into an appropriate power source.

SHOCK HAZARD:
For adequate external DC voltage, do **not** use a cigarette lighter as the terminal point. Ensure that the ambulance wiring leading to the terminal point is at least 10 gauge and as short as possible. Failure to do so could result in personal injury or equipment damage.

b. Using the accessory external DC power cord adapter, plug the external DC power cord into the transporting vehicle (see figure 6-4 on page 6-21).

1. Velcro® is a registered trademark of Velcro Industries, BV (a Dutch corporation).

Figure 6-4. DC Power Cord Receptacle Electrical Connections



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WARNING:
If the gas is released rapidly due to damage or another cause, compressed gas cylinders, such as oxygen cylinders, can become hazardous projectiles. To prevent movement or damage from shock or impact to the adjustable stand assembly or incubator, securely fasten the cylinders, and tighten the clamp screw as required.

12. Before installing an oxygen cylinder, ensure that the draw clamp keeper (N) is in the proper position for the size of oxygen cylinder being mounted on the incubator (see figure 6-5 on page 6-22).

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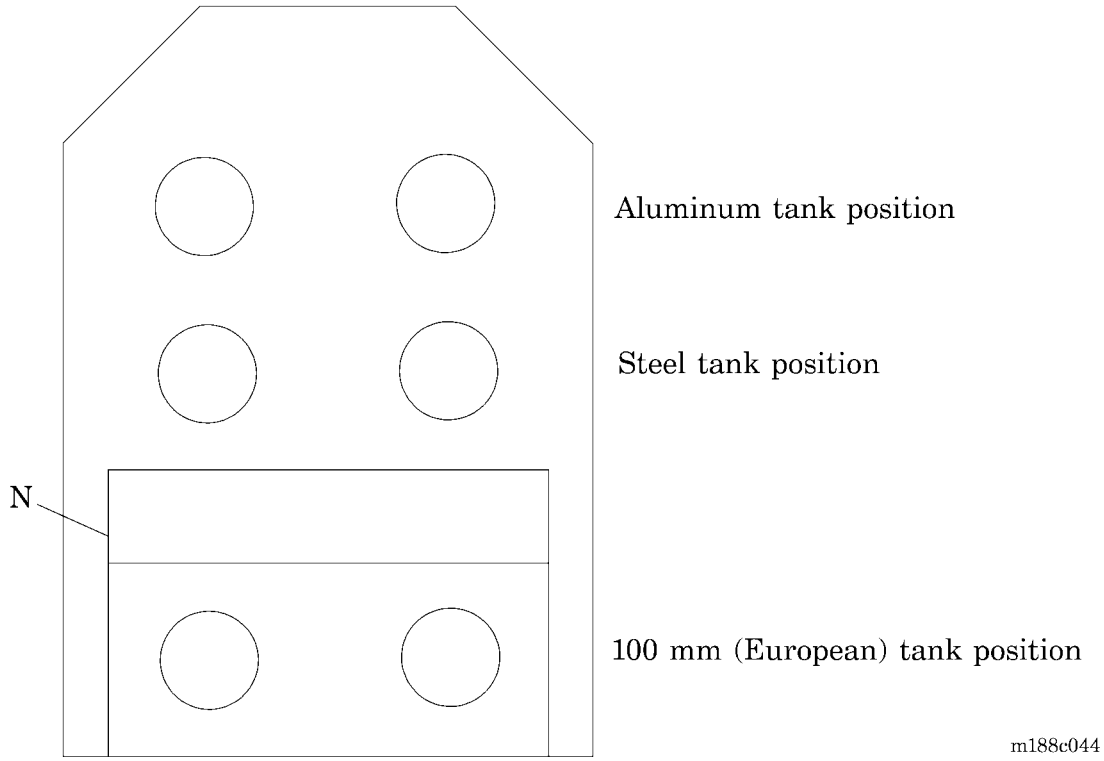
Figure 6-5. Draw Clamp Keeper Positioning



13. To install the oxygen cylinders, perform the following:
    a. Slide the oxygen cylinders, with the valve end toward the head end of the incubator, into the compartments (L) provided (see figure 6-3 on page 6-18).
    b. Tighten the retaining clamps (M) on the oxygen cylinders.
    c. Ensure that the oxygen cylinders are firmly clamped.
    d. To adjust the latch tension in the retaining clamp (M), turn the draw clamp (O) clockwise to increase tension or counterclockwise to decrease tension.
    e. Attach the accessory, oxygen pressure, regulator/flowmeter assembly to the oxygen cylinder.

6.3 Battery Maintenance

Tools required: None

Before the first use of the incubator, and at 3-month intervals thereafter, perform the following to check the condition of the batteries:

CAUTION:
If the incubator has not been plugged into an AC power source for 20 hours prior to this test, recharge the batteries by plugging the incubator into an AC power source for 20 hours with the **AC Power** switch in the ON-1 position. Failure to do so could result in equipment damage.

1. Ensure that the incubator has been plugged into an AC power source for 20 hours.
2. With the incubator in a room temperature environment, unplug it from its power source.
3. Open all access doors.
4. Turn the observation light on.
5. Press the **Set Temp** key. The **Set Temp** indicator lights, and a short beep sounds, indicating that the **°C Temperature** display is indicating the setpoint.
6. Observe the **°C Temperature** display, and press the Up arrow switch to raise the setpoint to its maximum, 38.0°C (100.4°F).

NOTE:
With fully-charged batteries, the incubator operates for at least 1¼ hours before the **Low DC** alarm activates.

7. If the **Low DC** alarm activates in less than 1¼ hours, replace the batteries.
8. Upon successful completion of the test, immediately plug the AC line cord, into an appropriate power source, and recharge the batteries for 20 hours.

6.4 Calibration

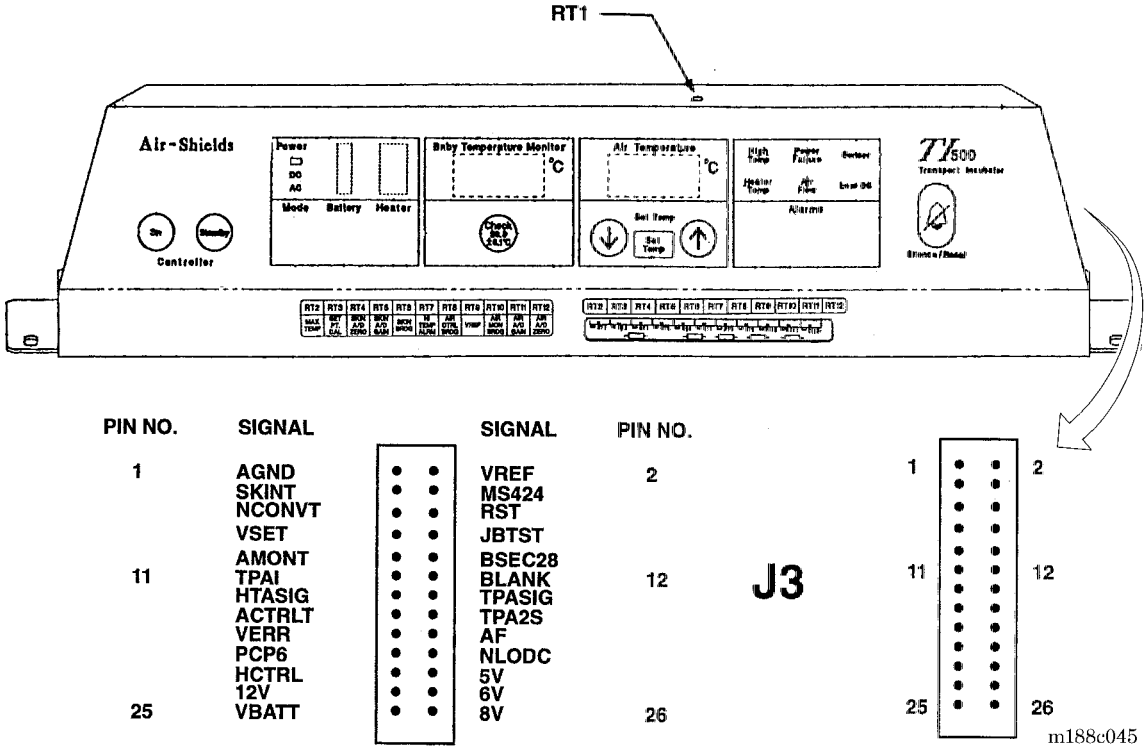
Tools required: Probe simulator (P/N 67 909 75)
Fluke®[1] Model 8087 digital voltmeter (DVM)
Sybron-Taylor Model QA580 oxygen analyzer
Victor Model 1099-0025 flowmeter
Bio-Tek®[2] Model 501 leakage current tester
Tektronix™[3] Model 561A oscilloscope

At least annually, and after any repair, perform the following to completely calibrate the equipment.

1. Remove the controller from the incubator.
2. Plug the incubator into an appropriate power source.
3. Turn the incubator and controller on.
4. Calibrate the reference voltage:
   a. Connect the Fluke® Model 8087 digital voltmeter (DVM) to J3-2 and J3-1 (GND) (see figure 6-6 on page 6-25).

1. Fluke® is a registered trademark of Fluke Corporation.
2. Bio-Tek® is a registered trademark of Bio-Tek Instruments, Inc.
3. Tektronix™ is a trademark of Tektronix, Inc.

Figure 6-6. Test Points



b. Adjust RT9 until the Fluke®[1] Model 8087 DVM reads 5.000V DC ± 0.005V DC.

5. Calibrate the clock period:

   a. Connect the Tektronix™[2] Model 561A oscilloscope to J3-4 and J3-1 (GND).

   b. Adjust RT1 for a clock period of 425 ms ± 10 ms on the Tektronix™ Model 561A oscilloscope.

6. Calibrate the skin temperature:

   a. Connect the probe simulator to the **Patient Probe** connector and J6 of the power supply P.C. board.

   b. Set the probe simulator to 36.0°C (96.8°F).

   c. Connect the Fluke® Model 8087 DVM between J3-1 (GND) and J3-3.

   d. Adjust RT6 for a reading of 3.62V DC ± 0.10V DC.

1. Fluke® is a registered trademark of Fluke Corporation.
2. Tektronix™ is a trademark of Tektronix, Inc.

e. For older probe simulators, set the probe simulator to 20.2°C (68.4°F). For newer probe simulators, set the probe simulator to 20.3°C (68.5°F).

f. Adjust RT4 until the **Baby Temperature** display agrees with the probe simulator setting.

g. Set the skin temperature probe simulator to 40°C (104°F).

h. Adjust RT5 until the **Baby Temperature** display reads 40°C (104°F).

i. Repeat until the probe simulator settings are obtained without further adjustment.

7. Calibrate the air temperature:

   a. Connect the air temperature probe simulator to the **Patient Probe** connector and J6 of the power supply P.C. board.

   b. Set the air temperature probe simulator to 36.3°C (97.3°F).

   c. Connect the Fluke®[1] Model 8087 DVM between J3-1 (GND) and J3-15.

   d. Adjust RT8 for a reading of 3.62V DC ± 0.01V DC.

   e. Connect the Fluke® Model 8087 DVM between J3-1 (GND) and J3-9.

   f. Set the air temperature probe simulator to 36.3°C (97.3°F).

   g. Adjust RT10 for a reading of 3.62V DC ± 0.01V DC.

   h. For older probe simulators, set the air temperature probe simulator to 20.1°C (68.2°F). For newer probe simulators, set the air temperature probe simulator to 20.2°C (68.4°F).

   i. Adjust RT12 until the **Air Temperature** display agrees with the probe simulator setting.

   j. Set the probe simulator to 38.9°C (102.0°F).

   k. Adjust RT11 until the **Air Temperature** display reads 38.9°C (102.0°F).

   l. Repeat until the probe simulator settings are obtained without further adjustment.

   m. For older probe simulators, set the probe simulator to 20.1°C (68.2°F). For newer probe simulators, set the probe simulator to 20.2°C (68.4°F).

   n. Press the **Set Temp** key. Verify that the **Set Temp** indicator comes on.

1. Fluke® is a registered trademark of Fluke Corporation.

NOTE:
Adjust RT3 only when the **Set Temp** indicator is on. If it goes off during the adjustment, press the **Set Temp** key again.

o. Adjust RT3 until the **Air Temperature** display reads 36.0°C (96.8°F).

p. Connect a jumper between U30-15 and U3-10.

q. Press the **Set Temp** key.

r. Press and hold the Up arrow key until the **Air Temperature** display stops changing.

NOTE:
Adjust RT2 only when the **Set Temp** indicator is on. If it goes off during the adjustment, press the **Set Temp** key again.

s. While holding the Up arrow key, adjust RT2 clockwise until the **Air Temperature** display reads 38.0°C (100.4°F).

t. Press the Down arrow key. Verify that the **Air Temperature** display reads 21.5°C (70.7°F) ± 1.5°C.

u. Press the Up arrow key until the **Air Temperature** display reads 36.0°C (96.8°F).

v. Remove the jumper from U30-15 and U3-10.

w. To verify full heater power, ensure that all four **Heater** lights are on. If not, adjust RT2 slightly counterclockwise.

8. Calibrate the high temperature:

   a. Turn the potentiometer RT7 fully counterclockwise.

   b. Set the probe simulator to 38.9°C (102.0°F).

   c. Connect the Fluke®[1] Model 8087 DVM between J3-1 (GND) and J3-13.

   d. Slowly adjust RT7 until the Fluke® Model 8087 DVM goes to Logic High. After 7 seconds, the **High Temp** indicator flashes, the alarm sounds, and the **Heater** indicators are off.

   e. Set the probe simulator to 36.3°C (97.3°F). The alarm ceases.

9. Check the chassis current leakage:

   a. Plug the power chassis into an appropriate power source through an ungrounded adapter plug so that the unit is ungrounded.

1. Fluke® is a registered trademark of Fluke Corporation.

b. Set the **Power** switch to the On-1 position.

NOTE:
The leakage test standards provided assume leakage through a resistance of 1000Ω.

c. If the Bio-Tek®[1] Model 501 leakage current tester does not provide a resistance of 1000Ω, provide it.

d. Using the Bio-Tek® Model 501 leakage current tester, measure between the chassis of the unit under test and a know ground connection of a wall receptacle.

e. On 100V/120V units, ensure that the leakage current does not exceed 300 µA. On 220V/240V units, ensure that the leakage current does not exceed 500 µA.

f. Reverse the plug.

g. Using the Bio-Tek® Model 501 leakage current tester, measure between the chassis of the unit under test and a know ground connection of a wall receptacle.

h. On 100V/120V units, ensure that the leakage current does not exceed 300 µA. On 220V/240V units, ensure that the leakage current does not exceed 500 µA.

i. Set the **Power** switch to the Off-0 position.

NOTE:
The leakage test standards provided assume leakage through a resistance of 1000Ω.

j. If the Bio-Tek® Model 501 leakage current tester does not provide a resistance of 1000Ω, provide it.

k. Using the Bio-Tek® Model 501 leakage current tester, measure between the chassis of the unit under test and a know ground connection of a wall receptacle.

l. On 100V/120V units, ensure that the leakage current does not exceed 300 µA. On 220V/240V units, ensure that the leakage current does not exceed 500 µA.

m. Reverse the plug.

1. Bio-Tek® is a registered trademark of Bio-Tek Instruments, Inc.

n. Using the Bio-Tek®[1] Model 501 current leakage tester, measure between the chassis of the unit under test and a known ground connection of a wall receptacle.

o. On 100V/120V units, ensure that the current leakage does not exceed 300 μA. On 220V/240V units, ensure that the current leakage does not exceed 500 μA.

10. Perform the oxygen concentration test:

a. Place a calibrated Sybron-Taylor Model QA580 oxygen analyzer on the mattress in the incubator.

b. Connect an oxygen supply through a Victor Model 1099-0025 flowmeter to the **Oxygen Inlet** connector on the side of the incubator.

c. Turn on the incubator.

d. Adjust the oxygen flow rate to 2.0 liters per minute (lpm) + 0.5 lpm.

e. Ensure that the hood oxygen concentration attains 30% to 47% oxygen within 30 minutes and then stabilizes.

f. Increase the flow rate to 6.0 lpm + 0.5 lpm.

g. Ensure that the hood oxygen concentration attains 58% to 90% within 30 minutes and then stabilizes.

1. Bio-Tek® is a registered trademark of Bio-Tek Instruments, Inc.

Tool and Supply Requirements

To service the Transport Incubator, the following tools and supplies are required:

- Phillips head screwdriver
- Screwdriver
- Probe simulator (P/N 67 909 75)
- Fluke®[1] Model 8087 digital voltmeter (DVM)
- Sybron-Taylor Model QA580 oxygen analyzer
- Victor Model 1099-0025 flowmeter
- Bio-Tek®[2] Model 501 leakage current tester
- Tektronix™[3] Model 561A oscilloscope
- Detergent/disinfectant
- Clean cloth or paper towels
- Warm water
- Air sanitizer
- 4Ω 100 W load resistor
- 1.5V batteries (2)
- 3/16" inner diameter surgical tubing

1. Fluke® is a registered trademark of Fluke Corporation.
2. Bio-Tek® is a registered trademark of Bio-Tek Instruments, Inc.
3. Tektronix™ is a trademark of Tektronix, Inc.

Chapter 7
Accessories

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NOTES:

Accessories

For Transport Incubator accessories, see table 7-1 on page 7-3.

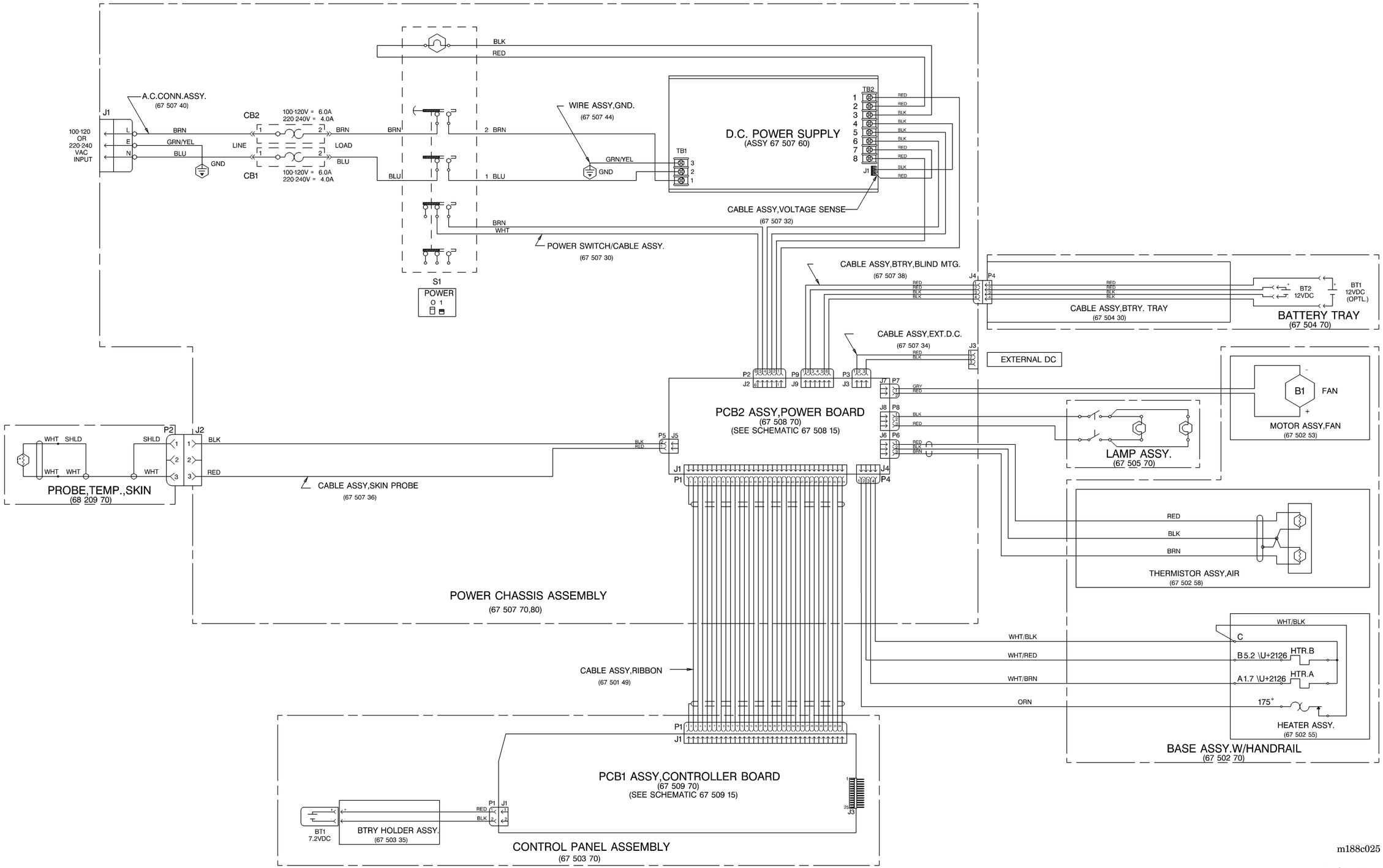
Table 7-1. Accessories List

Product Number	Description
67 091 80	IV pole assembly
67 090 72	Adjustable stand
67 503 30	Accessory shelf kit, English (Model TI500 only)
67 515 00	Accessory shelf kit, high, English (Model TI500-1/1E/1C only)
67 503 04	Second battery option
67 502 77	Cable assembly, DC external power adapter
67 090 75	Pressure regulator/flowmeter assembly, oxygen
67 361 41	Oxygen analyzer

NOTES:

Inter-Connection Diagram

Back to Chapter 3



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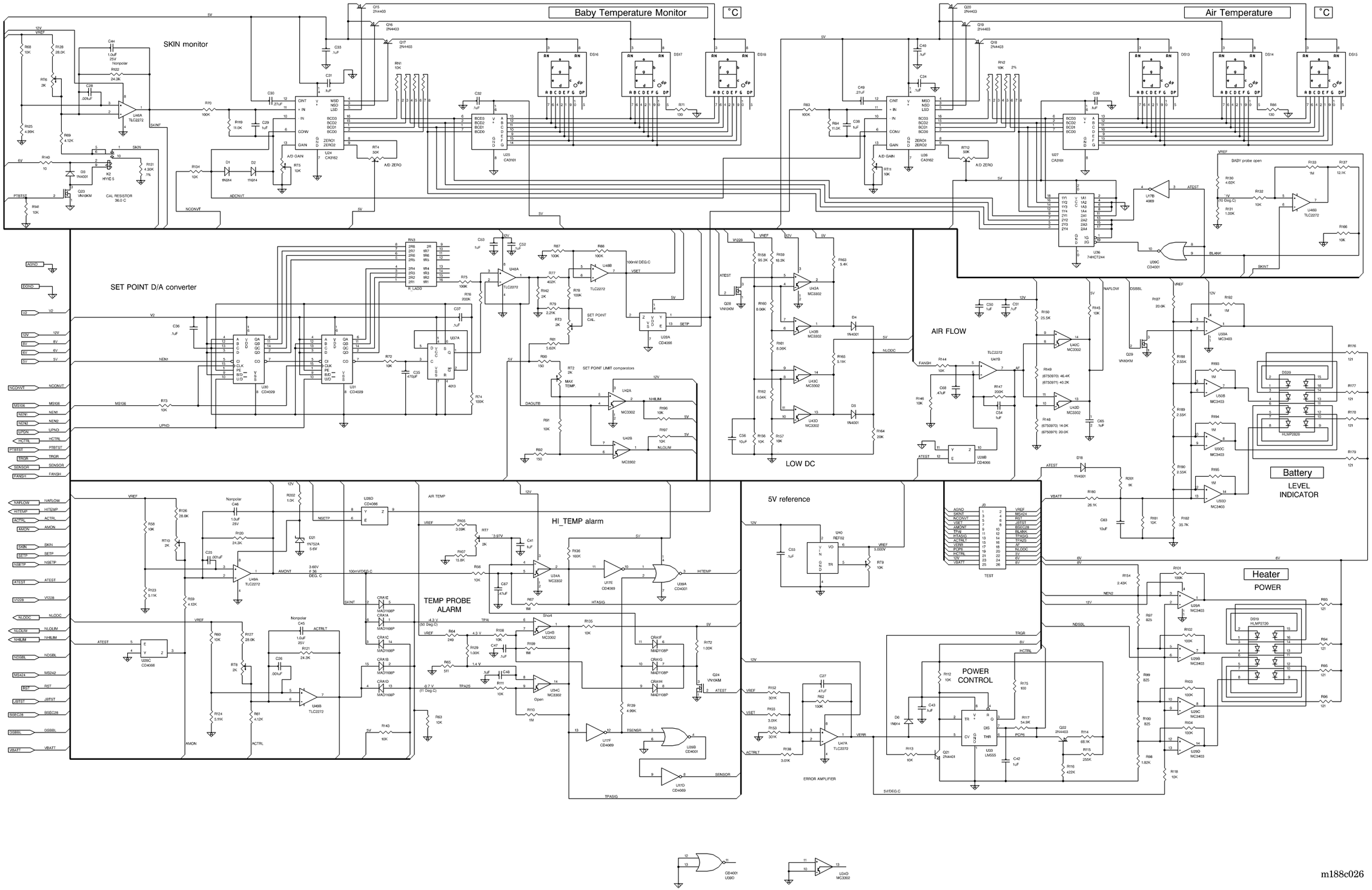
FO 3-1

Controller P.C. Board (PCB1) Schematic (Sheet 1 of 2)



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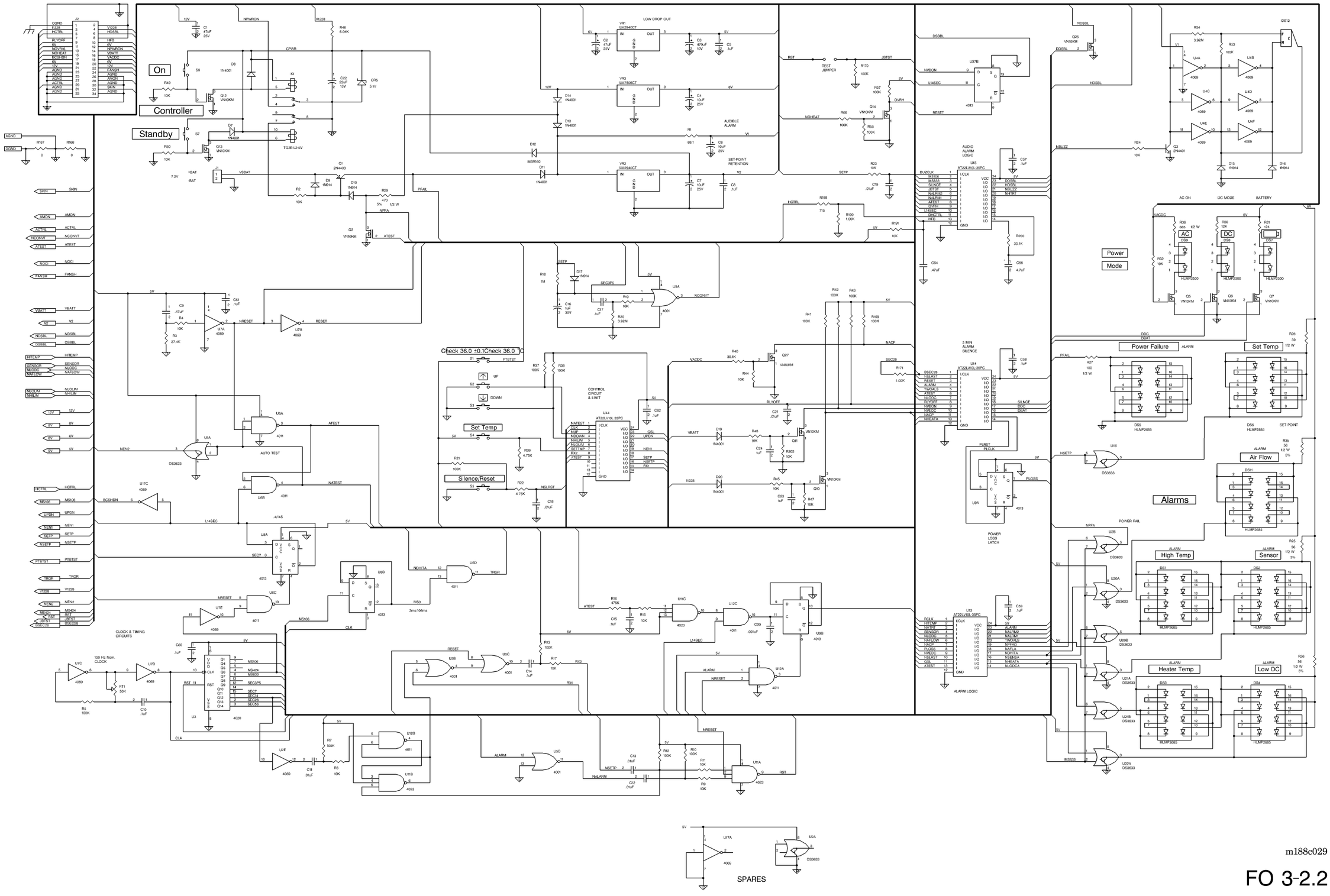
FO 3-2.1


On
Controller
Standby
Check 36.0 ±0.1Check 36.0
Set Temp
Silence/Reset
AUTO TEST
CLOCK & TIMING CIRCUITS
CONTROL CIRCUIT & LIMIT
AUDIBLE ALARM
SET-POINT RETENTION
AUDIO ALARM LOGIC
5 MIN. ALARM SILENCE
POWER LOSS LATCH
ALARM LOGIC
Power Mode
AC ON
DC MODE
BATTERY
Power Failure
ALARM
Set Temp
SET POINT
Alarms
High Temp
Sensor
Heater Temp
Low DC
Air Flow
POWER FAIL
SPARES
m188c029
FO 3-2.2

Power P.C. Board (PCB2) Schematic

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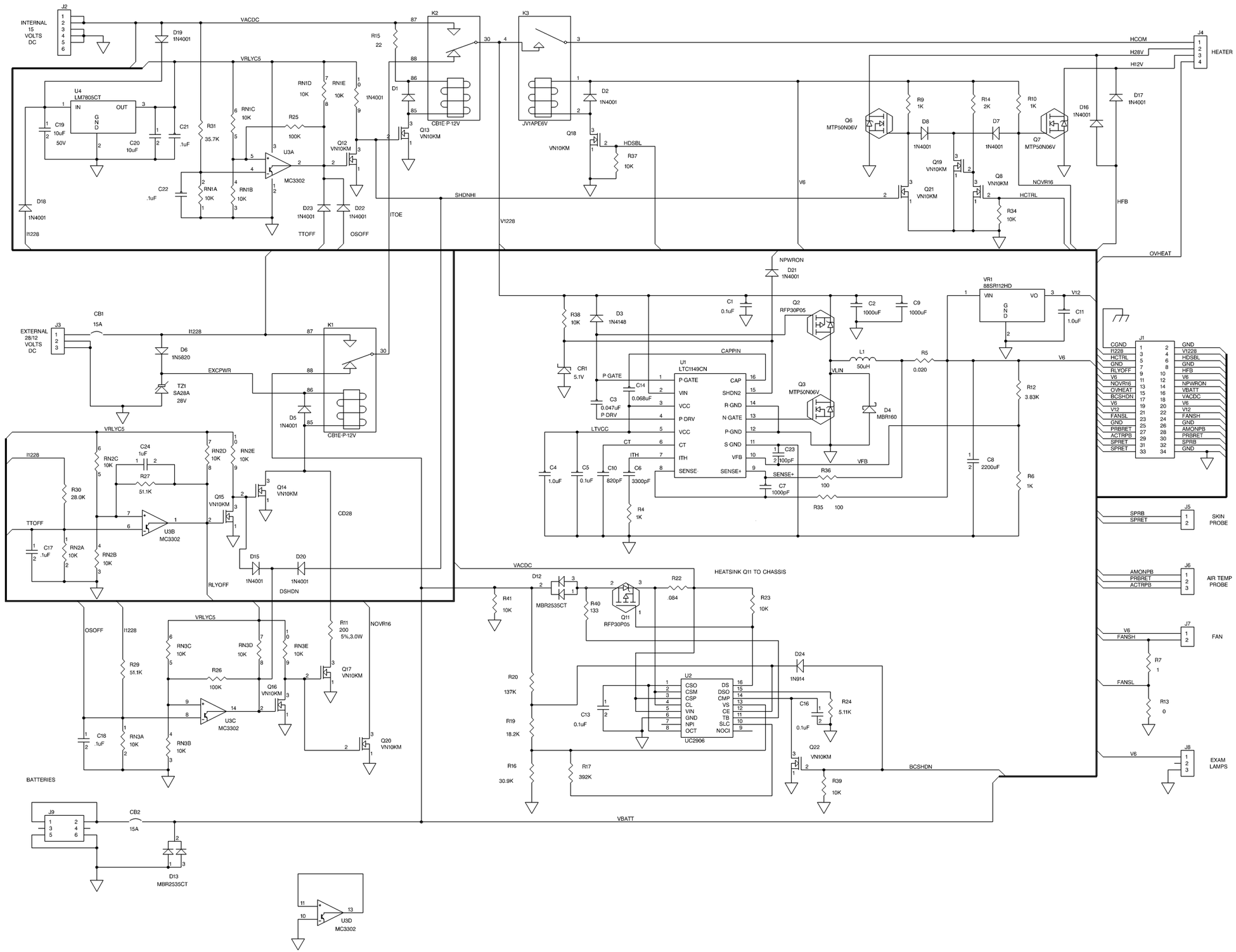
INTERNAL 15 VOLTS DC
EXTERNAL 28/12 VOLTS DC
VACDC
VRLYC5
I1228
SHDNHI
ITOE
V1228
TTOFF
OSOFF
DSHDN
RLYOFF
NPWRON
CAPPIN
VLIN
VFB
SENSE+
LTVCC
P-GATE
P-DRV
ITH
CT
V6
V12
HCOM
H28V
H12V
HEATER
HFB
OVHEAT
NOVR16
HCTRL
BCSHDN
VBATT
HEATSINK Q11 TO CHASSIS
BATTERIES
CGND
GND
HDSBL
VBATT
FANSH
FANSL
SPRB
SPRET
SKIN PROBE
AMONPB
PRBRET
ACTRPB
AIR TEMP PROBE
FAN
EXAM LAMPS
U1 LTC1149CN
U2 UC2906
U3A MC3302
U3B MC3302
U3C MC3302
U3D MC3302
U4 LM7805CT
VR1 88SR112HD
K1
K2
K3
CB1E-P12V
JV1APE6V
Q2 RFP30P05
Q3 MTP50N06V
Q6 MTP50N06V
Q7 MTP50N06V
Q11 RFP30P05
Q12 VN10KM
Q13 VN10KM
Q14 VN10KM
Q15 VN10KM
Q16 VN10KM
Q17 VN10KM
Q18 VN10KM
Q19 VN10KM
Q20 VN10KM
Q21 VN10KM
Q22 VN10KM
D1 1N4001
D2 1N4001
D3 1N4148
D4 MBR160
D5 1N4001
D6 1N5820
D8 1N4001
D12 MBR2535CT
D13 MBR2535CT
D15 1N4001
D16 1N4001
D17 1N4001
D18 1N4001
D19 1N4001
D20 1N4001
D21 1N4001
D22 1N4001
D23 1N4001
D24 1N914
TZ1 SA28A 28V
CD28
R15 22
R25 100K
R26 100K
R27 51.1K
R29 51.1K
R30 28.0K
R31 35.7K
R34 10K
R35 100
R36 100
R37 10K
R38 10K
R39 10K
R40 133
R41 10K
R4 1K
R5 0.020
R6 1K
R7 1
R9 1K
R10 1K
R11 200 5%,3.0W
R12 3.83K
R13 0
R14 2K
R17 392K
R22 .084
R23 10K
R24 5.11K
R36 100
L1 50uH
C1 0.1uF
C2 1000uF
C3 0.047uF
C4 1.0uF
C5 0.1uF
C6 3300pF
C7 1000pF
C8 2200uF
C9 1000uF
C10 820pF
C11 1.0uF
C13 0.1uF
C14 0.068uF
C16 0.1uF
C17 1uF
C18 1uF
C19 10uF 50V
C20 10uF
C21 .1uF
C22 .1uF
C23 100pF
C24 1uF
RN1A 10K
RN1B 10K
RN1C 10K
RN1D 10K
RN1E 10K
RN2A 10K
RN2B 10K
RN2C 10K
RN2D 10K
RN2E 10K
RN3A 10K
RN3B 10K
RN3C 10K
RN3D 10K
RN3E 10K
R18 137K
R19 18.2K
R16 30.9K
R20 137K
R41 10K
R23 10K
R39 10K
R7 1
R13 0
R6 1K
R4 1K
R35 100
R36 100
R37 10K
R34 10K
R38 10K
R40 133